# Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

MAY, 1952

TECHNOLOGY DEPT.

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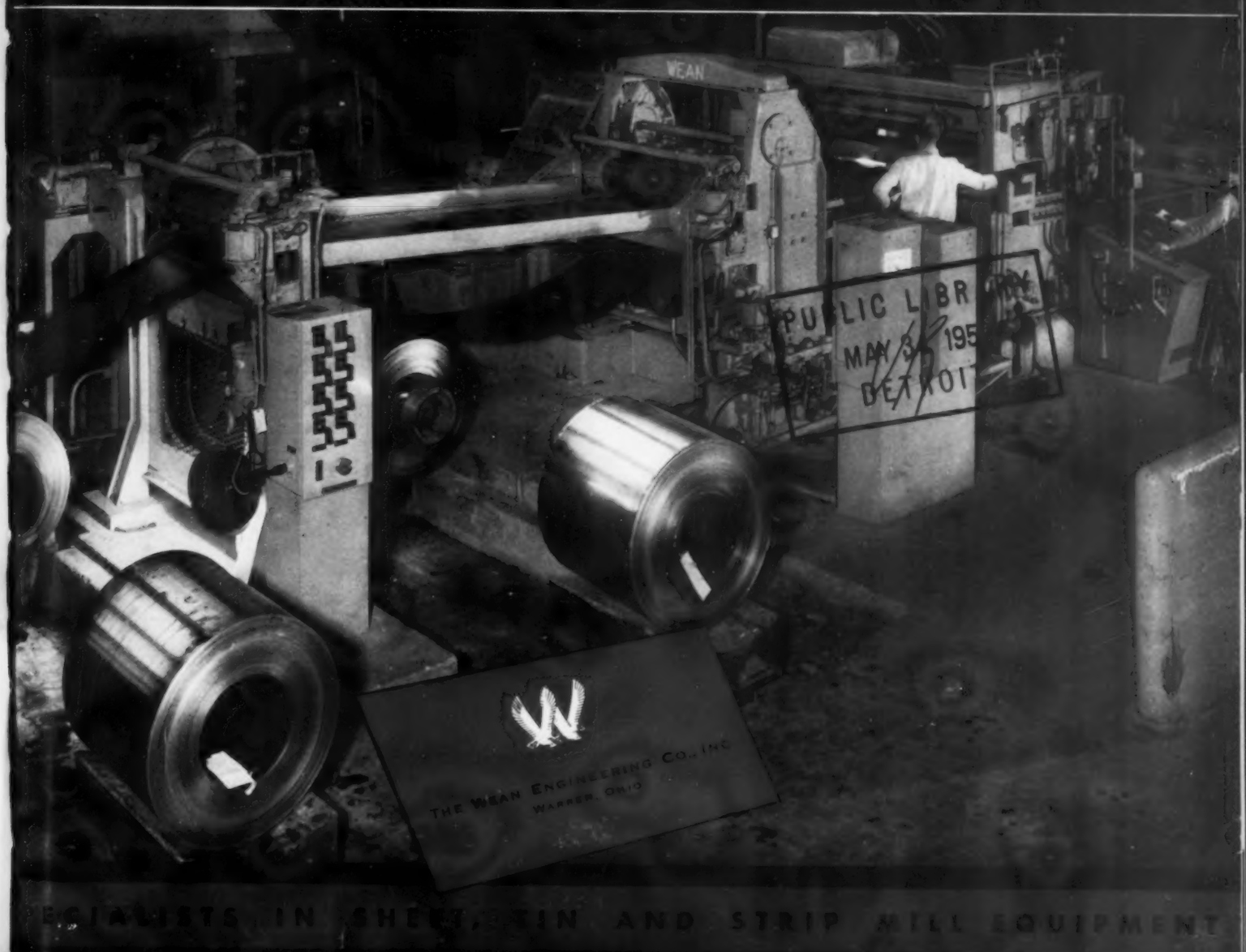
The WEAN ENGINEERING COMPANY INC.
WARREN, OHIO

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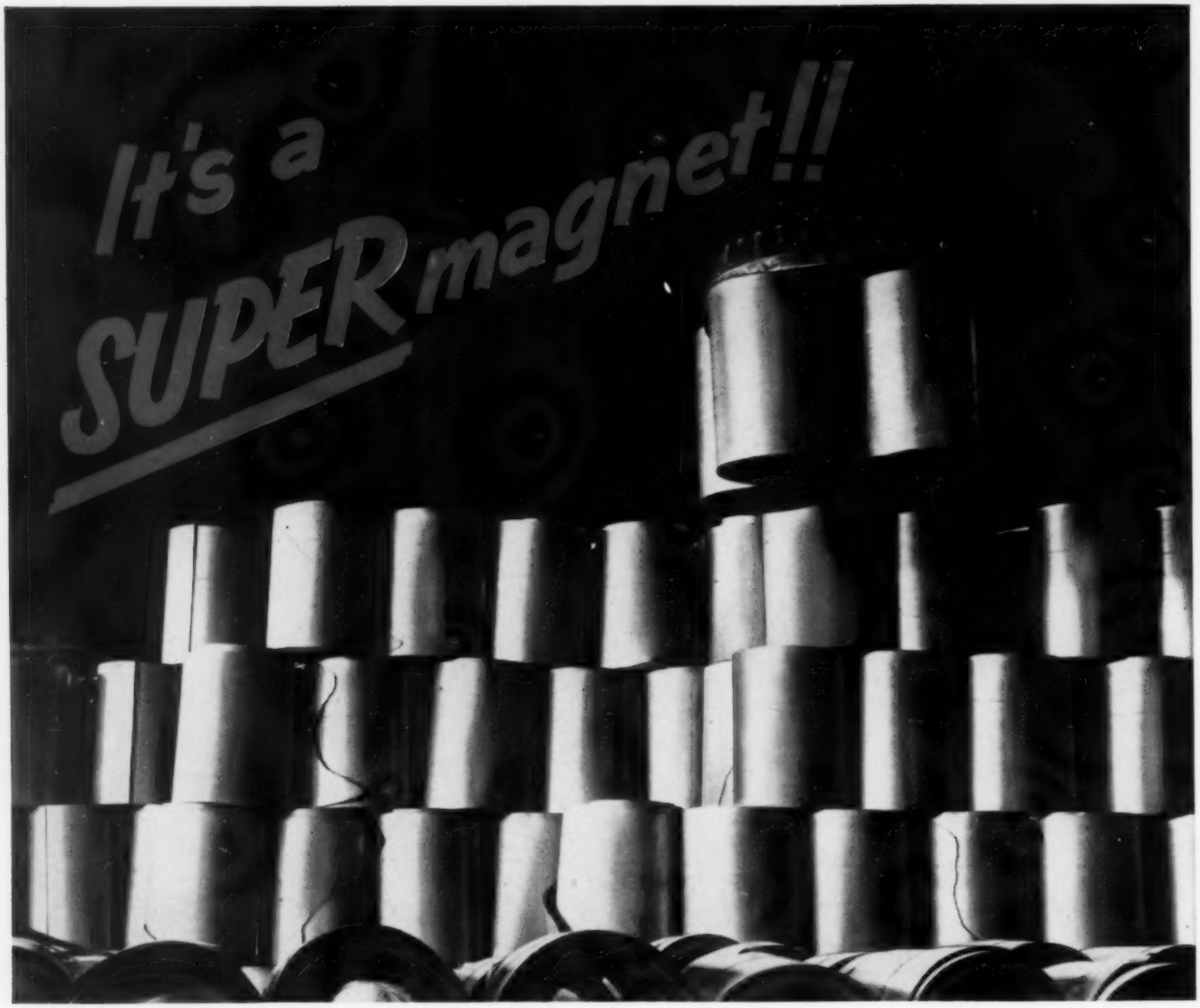
SPECIALISTS IN SHEET, TIN AND STRIP MILL EQUIPMENT




## Its record proves what its construction promises

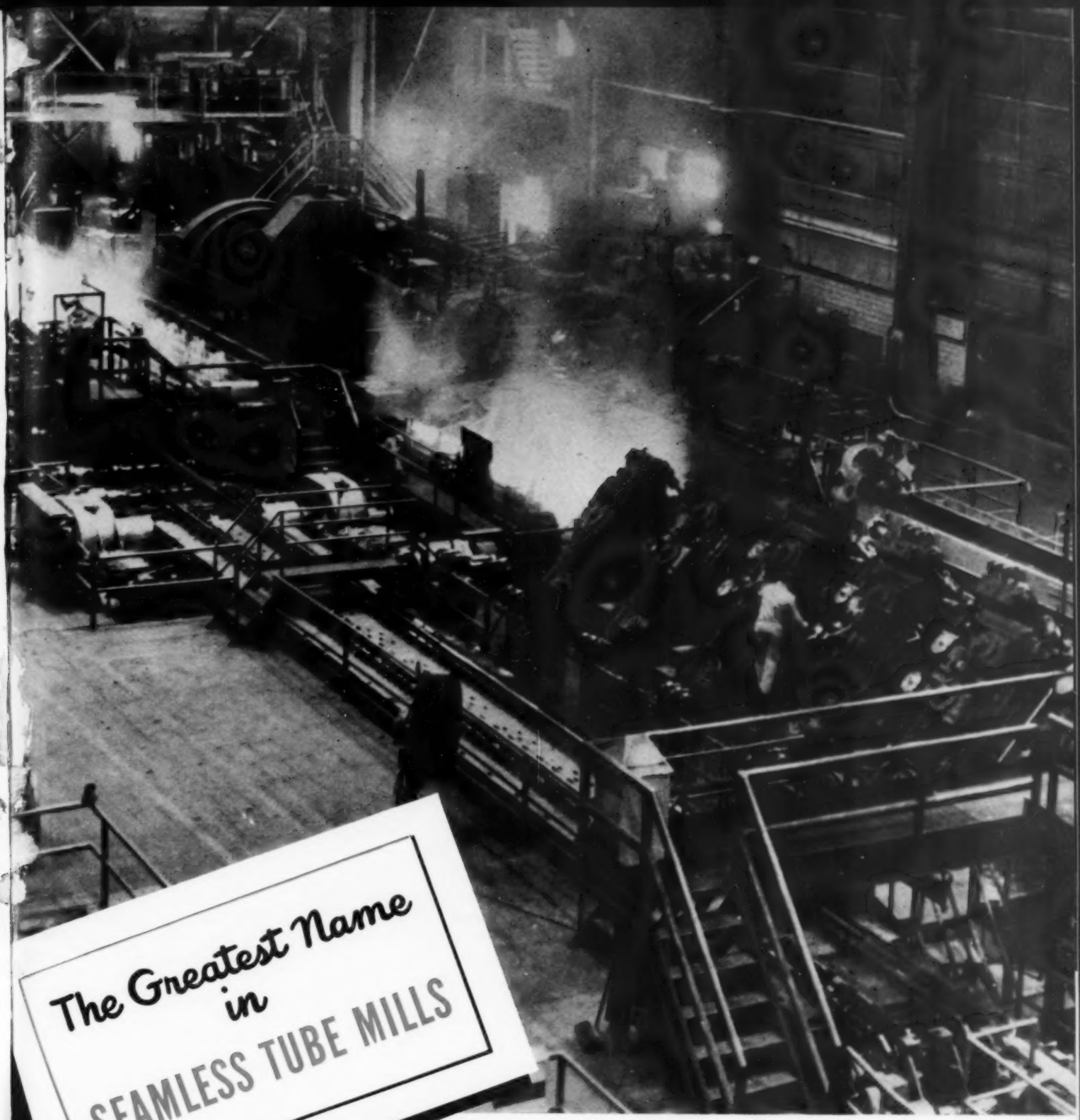
Men who have operated Cutler-Hammer Lifting Magnets during the past 50 years know their record. In steel mills, scrapyards and foundries . . . on railroads, ships and docks these Magnets have earned a reputation for dependable performance day after day, year after year, with little time out-of-service.

Any electrical engineer can tell you the secret of these Magnets' lifting power. It's in the coil, and in the construction. The makers of Cutler-Hammer Supermagnets wind the coils under tension to provide maximum copper density. They vacuum-impregnate the coils with a special compound, then bake the coils to form a solid monolithic mass and insure against air pockets. They sheath this solid mass in a welded sheet-steel housing. That makes coil moisture troubles a thing of the past. They build the body of dynamo steel to add lifting power. They make the pole shoes out of tough alloy that resists wear and adds strength. They double seal the terminal box to make it watertight. And they have designed a yoke that keeps chains separate and stops twisting. That adds to chain life.

CUTLER-HAMMER
SUPERMAGNETS
C-H

These are just some of the features that make Cutler-Hammer Supermagnets the preferred choice wherever iron and steel are handled. Users *know* these facts. You can learn them for yourself by specifying Cutler-Hammer the next time you buy a magnet. CUTLER-HAMMER, Inc., 1257 St. Paul Avenue, Milwaukee 1, Wisconsin.

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress, March 3, 1879. $7.50 per year in United States and Canada, $10.00 foreign countries. Volume 29, No. 5.




# Aetna-Standard

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

Plants in Warren, Ohio · Ellwood City, Pennsylvania

ASSOCIATED COMPANIES

**Head Wrightson Machine Company, Ltd., Middlesbrough, England**—Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.

**Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.**

**M. Castellvi, Inc., New York, N. Y.**—Mexico, Central and South America.

**Societe de Constructions de Montbard, Paris, France**—France, Belgium, Holland, Luxembourg, Switzerland.

**Demag Aktiengesellschaft, Duisburg, Germany**—Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.

**Compagnia Italiana Forme Acciaio, Milano, Italy**—Italy.

**Aetna-Japan Company, Ltd., Tokyo, Japan**—Japan.

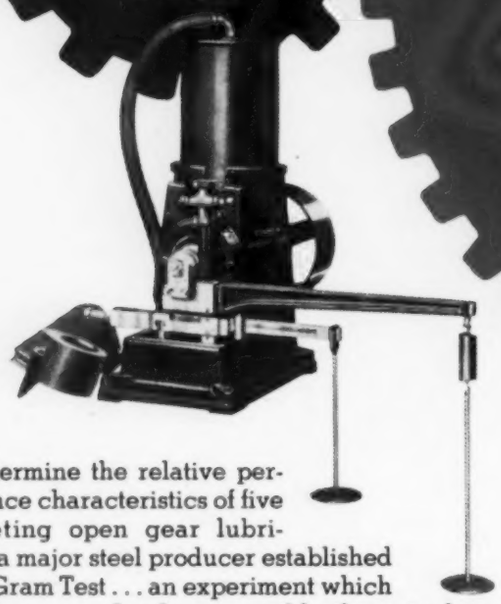
**Hale & Kullgren, Inc., Akron, Ohio**—Representative for the Rubber Industry.

*Designers and Builders to the Ferrous, Non-Ferrous, Leather and Rubber Industries*

INDEPENDENTLY CONDUCTED

# 4-GRAM TEST

# —PROVES LEADOLENE Klingfast BEST FOR LUBRICATING OPEN GEARS



To determine the relative performance characteristics of five competing open gear lubricants, a major steel producer established the 4-Gram Test . . . an experiment which reproduces as closely as possible the actual service conditions encountered in open gear and sleeve bearing lubrication.

In this test the Timken Testing Machine, recognized as standard equipment for testing lubricants, was modified slightly to reproduce more precisely actual service conditions. The hardened and ground steel block and cup, indicated at right, normally is under constant lubrication. However, in the 4-Gram Test the flow of lubrication was cut off and 4 grams of the lubricant being tested were applied at room temperature. The machine then was set in motion and watched closely for signs of scoring.

Five lubricants, all accepted in industry as "good quality," were tested. *Results of the test showed that LEADOLENE KLINGFAST gave over 3½ times the service of the next best lubricant and up to 6 times the service of the other lubricants tested.*

Since open gears are lubricated periodically and not constantly, the pH-ilm must have lasting characteristics. Thus, this test is truly representative of actual field operation tests for open gears. The enduring action together with extremely high pH-ilm strength guarantee the machine actual lubrication and protection.

In testing . . . and more important, in actual service . . . LEADOLENE KLINGFAST regularly gives comparable performances. A product of 76 years of manufacturing experience, it is a lead-based lubricant with an "Indestructible pH-ilm," capable of withstanding pressures up to 50,000 psi. With LEADOLENE KLINGFAST you profit in two ways: from lowered lubrication costs due to less frequent application, and from greater service life from the machinery being lubricated.

*Write for technical data or samples for your own testing.*

## THE BROOKS OIL CO.

Since 1876

Executive Offices and Plant.....CLEVELAND, OHIO
Executive Sales Offices.....PITTSBURGH, PA.
Canadian Offices and Plant.....HAMILTON, ONTARIO
Cuban Office.....SANTIAGO de CUBA

## Results OF 4-GRAM TEST

**LEADOLENE KLINGFAST**
**30 MINUTES**
without scoring or failing.

**LUBRICANT "A"**
**5 MINUTES**
A high grade compound scored at 5 minutes and failed in 12 minutes.

**LUBRICANT "B"**
**8 MINUTES**
A reputable lubricant of residual nature scored and failed in 8 minutes.

**LUBRICANT "C"**
**6 MINUTES**
A good lead compounded extreme pressure lubricant scored and failed in 6 minutes.

**LUBRICANT "D"**
**6 MINUTES**
A lead-compounded lubricant scored and failed in 6 minutes.

Mesta workmen tap a heat of quality alloy steel in the Electric Furnace Department.

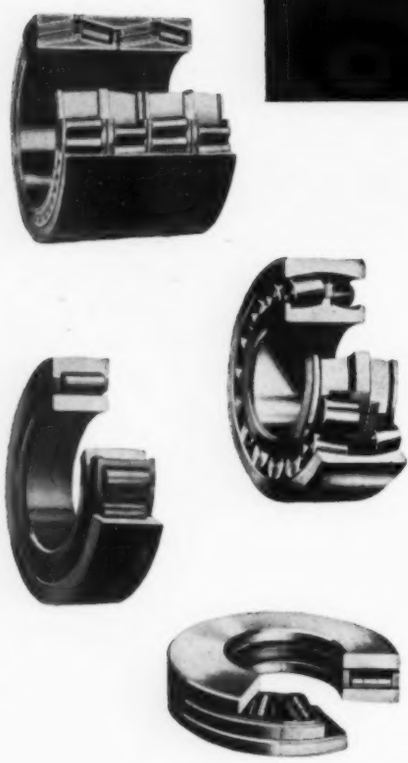
# Electric Furnace Department at MESTA

*Designers and Builders of Complete Steel Plants*

**MESTA MACHINE COMPANY**

PITTSBURGH, PENNSYLVANIA

# pulling together...



Working closely with makers and users of all kinds of equipment—from small appliances to giant rolling mills—Torrington engineers have helped solve countless problems involving bearing design, installation and maintenance. They have had many years of experience in the manufacture and application of *all* types of anti-friction bearings.

Have you a friction problem? Would you like to know more about a certain type of bearing in terms of your product? Then call in a Torrington engineer. He will be glad to work with you.

THE TORRINGTON COMPANY

South Bend 21, Ind. Torrington, Conn.

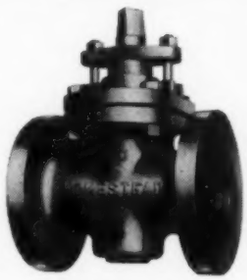
*District Offices and Distributors in Principal Cities of United States and Canada*

## TORRINGTON BEARINGS

**Spherical Roller • Tapered Roller • Straight Roller • Needle • Ball • Needle Rollers**

# WE MAKE *ALL* TYPES OF PLUG VALVES
## . . . including the *right* one for *your* needs

### HOMESTEAD CAM-SEALD



Straight-way—
Flanged or Screw Ends

Three-way—Screw or Flanged Ends

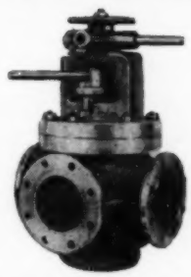
Four-way—Flanged or Screw Ends

**HOMESTEAD CAM-SEALD, QUARTER-TURN PLUG VALVES**
(non-lubricated, or pressure-gun lubricated, as desired)

Available in metals for most valve needs; for pressures to 3,000 lbs.; temperatures to 750° F.

### HOMESTEAD LEVER-SEALD

Straight-way—
Flanged or Screw Ends



Three-way—Flanged or Screw Ends

Four-way—Flanged or Screw Ends

**HOMESTEAD LEVER-SEALD, QUARTER-TURN PLUG VALVES**
(non-lubricated, or pressure-gun lubricated, as desired)

Made in combinations of metals and alloys to meet practically any service requirement; from 1½" to 10"; from vacuum to 1,500 pounds.

### HOMESTEAD-REISER

Straight-way—
Screw or Flanged Ends

Straight-way—
Worm & Gear Operated

Flow-Changer—Non-lubricated

**HOMESTEAD-REISER SELF-SEALD LUBRICATED PLUG VALVES**
(100% Port Area, or Venturi, as desired)

Available in semi-steel; cast steel; sizes ½" to 12" for steam pressures to 150 lbs.; oil-water-gas to 200 pounds.

We are the only manufacturer who makes *all* of the various types of plug valves used in industry . . . LUBRICATED . . . NON-LUBRICATED . . . FULL PORT . . . VENTURI. We have no "leaders." *We make them all;* therefore, we have no reason to "push" one type valve over another. Our only concern is to see that you get the *right* valve for *your* requirement.

To help you keep this in mind the next time you need plug valves, we'd like to send you our catalog. Why not write for it today.

**HOMESTEAD VALVE MANUFACTURING COMPANY**
**P. O. BOX 21** **CORAOPOLIS, PA.**

*Serving since 1892*

# CONTINUOUS STRIP ANNEALING in DREVER VERTICAL FURNACES

## *Saves Time • Reduces Cost*

Outstanding PRODUCT

A Uniformly annealed strip from edge to edge and end to end of coil

B Uniform Physicals throughout the coil

C Clean, Lustrous Surface that electro-tins uniformly

D Stickers and "Dog Ears" eliminated

E Users of Continuous Annealed Strip report longer die and shear life

Drever Company has pioneered this striking improvement in Continuous Annealing Furnaces for Tin Plate Strip, Silicon Strip, Blue Plate and other strip products. We predict all major steel mills will anneal by this method. Why don't *you* do it now?

Equipment can be specified for output up to 30 tons per hour of 30″ wide x .010″ thick low carbon steel. Several sizes are available, in any width.

Furnace illustrated produces Tin Plate and Blue Plate. The shift-over from the Bright Surface required for Tin Plate to the uniformly applied, accurately controlled tight oxide coating required for blue plate is rapidly and easily made.

**Installations backed by staff of Engineers and Metallurgists of sixteen years experience in Continuous Annealing of Low Carbon Strip.**

Outstanding DESIGN

1 Speeds up to 1000 feet per minute

2 Controlled Strip Tension, excellent tracking

3 Controlled Heating and Soaking Time

4 Regulated Cooling Rate

5 Predictable Strip Temper

6 Cleaning in same line

7 Low Maintenance

8 Reduction in Floor Space

9 Reduction in Coil Inventory

10 Overall Saving in Annealing and Cleaning Costs

DREVER CO.
730 E. VENANGO STREET
PHILADELPHIA 34, PENNA.

# Continental

## CONTINUOUS BILLET and BAR MILL

## Complete Rolling Mill Installations:

BLOOMING MILLS • STRUCTURAL MILLS • RAIL MILLS
BILLET MILLS • ROD MILLS
BAR MILLS • MERCHANT MILLS • SLABBING MILLS
UNIVERSAL MILLS • PLATE MILLS
HOT STRIP MILLS • COLD STRIP MILLS • TEMPER MILLS
ROLL LATHES • SPECIAL MACHINERY

CASTINGS—carbon and alloy steel from 20 to 250,000 pounds

ROLLS—iron, alloy iron and steel rolls for all types of rolling mills

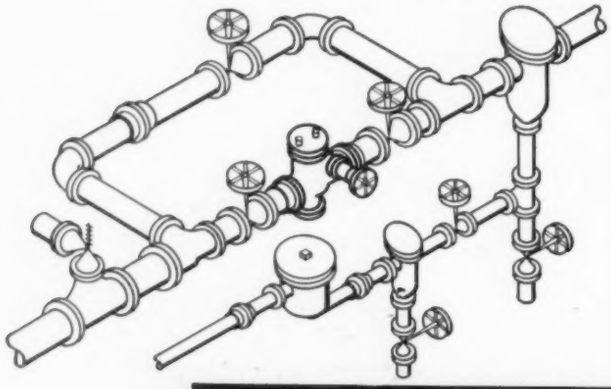
CHICAGO • PITTSBURGH

Plants at: *East Chicago, Ind.* • *Wheeling, W. Va.* • *Pittsburgh, Pa.*

CONTINENTAL
Foundry & Machine
Company

# Can Your Pressure Regulators Match This Service Record?

## ...on a Steam Kettle for instance



### THE INSTALLATION

On steam supply line to cooking kettle, Schoenling Brewing Company, Cincinnati.

### VALVE SERVICE RATINGS

| | |
|---|---|
| **SERVICE LIFE:** | 16 years - 24 hours per day |
| **MAINTENANCE COST:** | None - simple servicing only |
| **SPECIAL FEATURES:** | Good pressure range - easy adjustment |
| **SUITABILITY:** | Steady flow - no pressure build-up |
| **OPERATING RESULTS:** | Accurate control of cooking process |
| **PRICE:** | Low - considering service life |
| **AVAILABILITY:** | Stock item - Crane line |

### THE HISTORY

Specifications for this installation called for a regulator to reduce main line steam supply at 100 psi to 30 psi, and automatically maintain the reduced pressure to cooker, 24 hours daily, without significant fluctuation.

A Crane Pressure Regulator with factory pre-set range was selected and properly installed with adequate, automatic drainage of the steam lines.

For 16 years, throughout its lifetime, the Crane Pressure Regulator did its job to the brewery's complete satisfaction. Never was it out of service; never did it require more than the simple prescribed periodic inspection. (Note: current model has renewable wearing parts; will virtually never wear out.)

### THE VALVE

Crane No. 960 Brass Pressure Regulators are made for reducing steam or air pressures up to 250 pounds, to within 80% of inlet pressure. They are factory pre-set to operate within any of 4 ranges from 1 to 200 pounds, with easily selected outlet pressure within set range. Precision made, they are fully automatic, highly dependable, even under reasonable fluctuation of inlet pressure. All wearing parts renewable. See your Crane Catalog or Crane Representative for complete data.

*The Complete Crane Line Meets All Valve Needs. That's Why*

**More Crane Valves Are Used Than Any Other Make!**

# CRANE VALVES

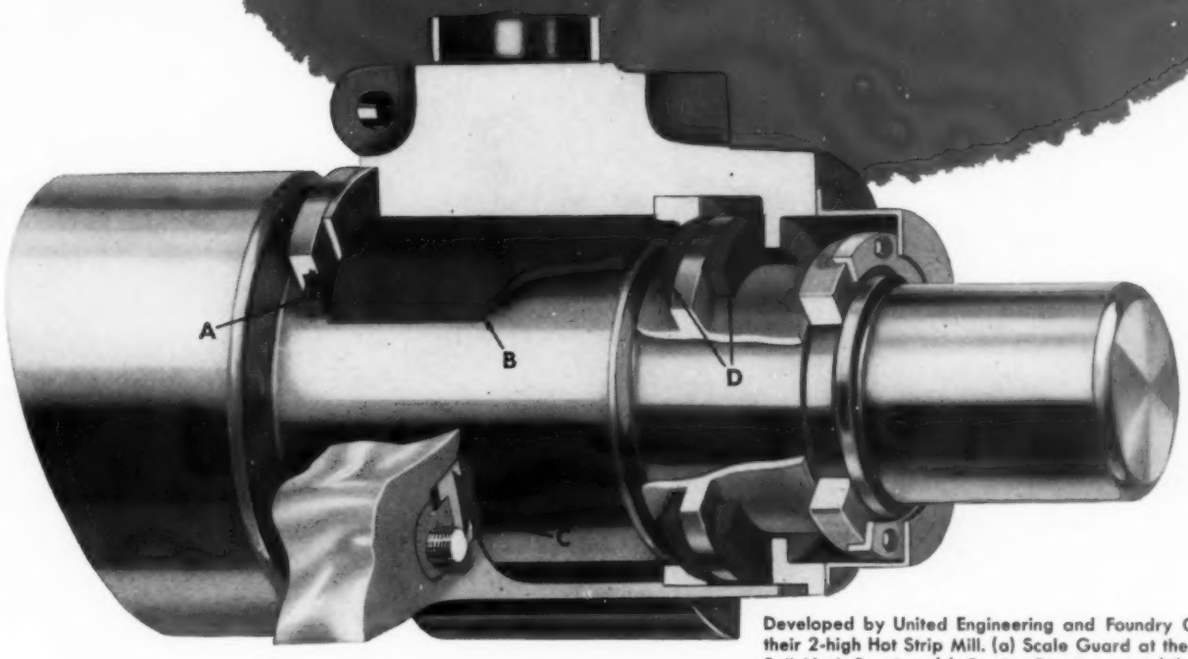
CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois

*Branches and Wholesalers Serving All Industrial Areas*

***VALVES • FITTINGS • PIPE • PLUMBING • HEATING***

# NEW...

## Enclosed roll neck assembly with A·B·K bearings for more efficient mill operation

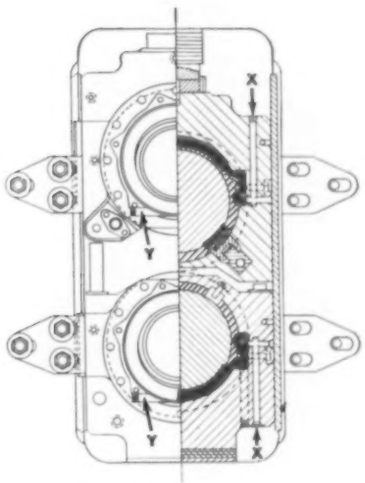



Developed by United Engineering and Foundry Company for their 2-high Hot Strip Mill. (a) Scale Guard at the roll fillet; (b) Roll Neck Bearing; (c) Carrier Bearings and (d) Thrust Rings.

Fully enclosed, and made from A-B-K laminated plastic. Scale can't reach the bearing surfaces. Lubrication by water is ample and fully controlled; yet oil or grease can be easily added to prevent rust during mill shutdown.

Thus to A-B-K material's advantages of longer bearing life, exceptional resistance to shock and low coefficient of friction is added complete bearing protection, at all times.

Investigate A-B-K Roll Neck Bearings, Thrust Collars and Slipper Bearings. They save power, permit better holding of gauge, sharply reduce down time and maintenance costs. Various formulas are available. Write for our new folder, American Brakeblok Division, 4600 Merritt Avenue, Detroit 9, Michigan.




The position of the bearings on the roll neck and provisions for lubrication. "X" is the inlet port, "Y" the outlet.

AMERICAN Brake Shoe COMPANY

Copyright 1952, The American Brake Shoe Co.

AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN

# ROLLING MILL DRIVE
## with the accent on *Reliability*

Photo courtesy of United States Steel Company — E. W. Bliss Company mill show

Elliott
FABRI-STEEL
MOTORS AND GENERATORS

The six Elliott motors and generators in this rolling mill installation illustrate the successful combination of *progressive design*, extreme care in *materials selection*, and highest degree of *precision* in craftsmanship. The end result is the *reliability* essential to rolling mill operation—a quality for which Elliott motors and generators are noted throughout all industry. For details on equipment illustrated, write us.

1 Two tandem-coupled 500-hp, 250/965-rpm recoiler motors.

2 Two 600-hp, 450/1000-rpm main roll twin-drive motors.

3 Two 150-kw, 300/1200-rpm drag generators.

The 2100-kw Elliott motor-generator set furnishing variable voltage power to these machines, is installed below the mill floor.

MR-9

ELLIOTT COMPANY

DEPARTMENT IS
Ridgway Division • Ridgway, Pa.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
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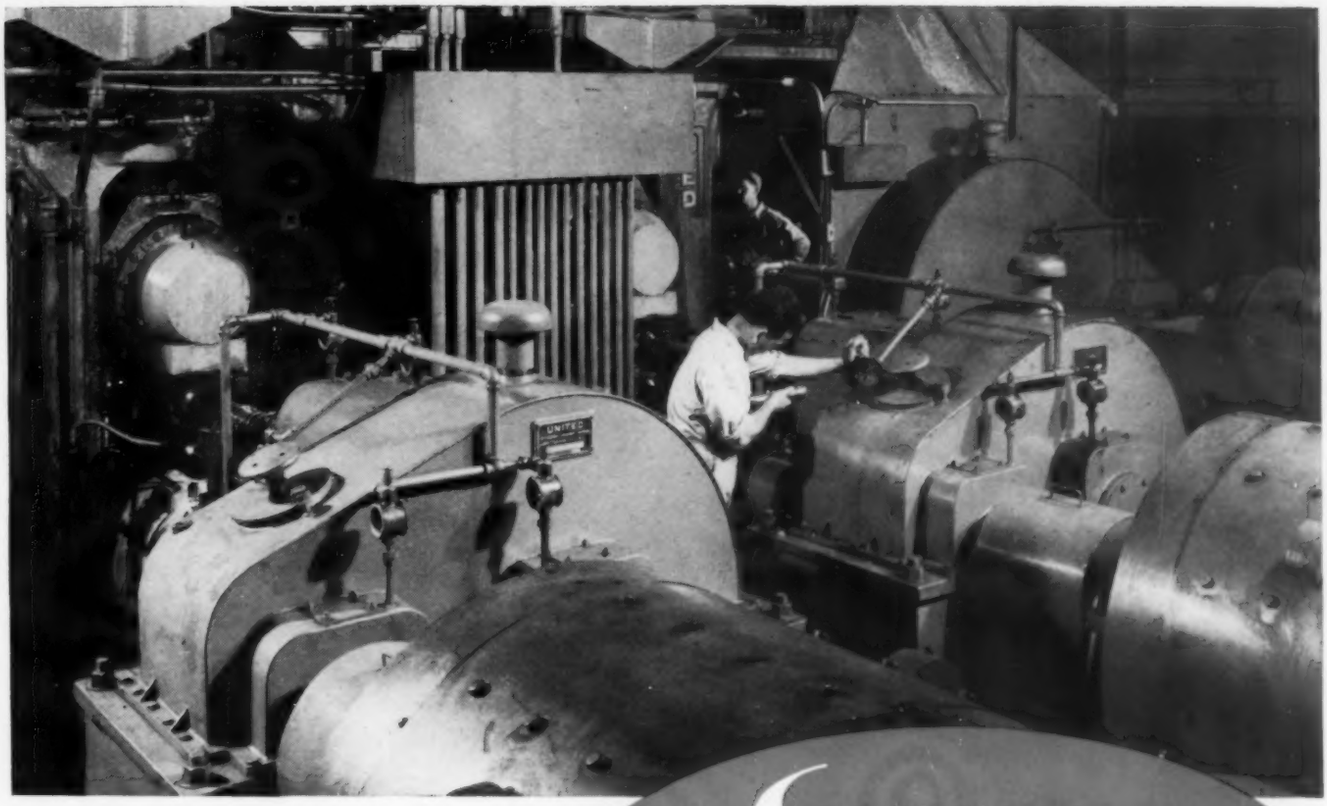


An *extra* margin of protection for

**PINION STANDS**
**REDUCTION GEARS**
**SCREW DOWNS**

# —GULF E. P. LUBRICANTS

Steel men who have had experience with Gulf E. P. Lubricants generally agree that they do two jobs better than most other extreme pressure lubricants.

First, they prevent metal-to-metal contact and excessive wear under shock loads and high pressures encountered in the toughest service. They are ideal for screw downs, pinion stands, reduction gears, and table drives.

Second, they are outstanding in their ability to separate from water. When the proper grade is used and good maintenance practice is employed, most lubrication difficulties caused by water can be avoided.

And they have other advantages, too. They are nonfoaming, tenacious, extremely stable for this type of lubricant, and they help prevent rust. In addition to being good gear lubricants, they are equally suitable for the lubrication of most types of bearings.

Gulf E. P. Lubricants are available in the proper viscosity for every gear requirement, ranging from 55 to 1050 S.U.V. at 210°F. For specific recommendations for your equipment, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office.

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation · Gulf Refining Company IS
719 Gulf Building, Pittsburgh 30, Pa.

Please send me, without obligation, a copy of your pamphlet "Gulf E.P. Lubricants."

Name.....

Company.....

Title.....

Address.....

Lee Wilson

# ANNEALING FURNACE DATA SHEET

**NUMBER FOUR**

**BASIC ADVANTAGES OF LEE WILSON SINGLE-STACK PORTABLE BASE FURNACES:**

1. BETTER QUALITY
2. HIGHER PRODUCTION
3. LOWER FUEL COSTS
4. LOWER FIRST COST
5. LOWER MAINTENANCE
6. LOW HANDLING COSTS

# PORTABLE BASE FURNACE MINIMIZES INSTALLATION COSTS

The new Lee Wilson Portable Base Single-Stack System is the most efficient method of coil annealing available today.

Fewer units are required, no expensive basements or under structures are needed, smaller cranes and lighter building construction can be utilized and less floor space is required.

Because of the larger radiation capacity of a single-stack furnace it will produce roughly twice as much tonnage per stack as multiple-stack units. Thus fewer units are required to produce a given tonnage.

## THE ONLY PORTABLE BASE—

The Lee Wilson Portable Base is truly portable and easily handled by light crane equipment. By simply breaking three connections the base can be picked up and taken to a maintenance station for any necessary work. This eliminates the large basements required for repair work by furnaces other than the new Lee Wilson.

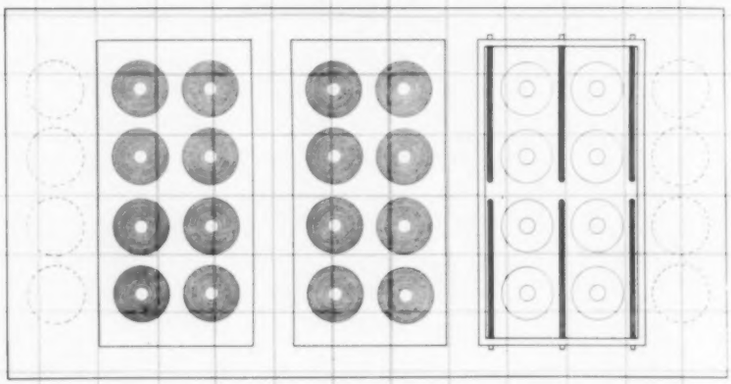


**Fig. 1 Floor space, too, is conserved. Due to faster heating and cooling and better load factor obtainable by employing the Lee Wilson Portable Base Single-Stack System—fewer furnaces are required. Thus less floor space is needed for a given tonnage.**

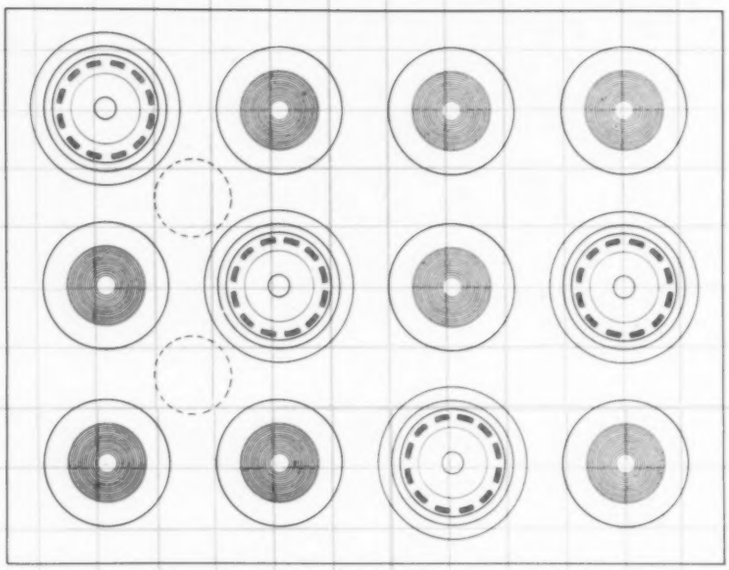


**Fig. 2 Additional space for inner cover storage is unnecessary. Inner covers are stored handily between furnaces (Figs. 1 & 2) and only one inner cover need be handled in a charge change.**

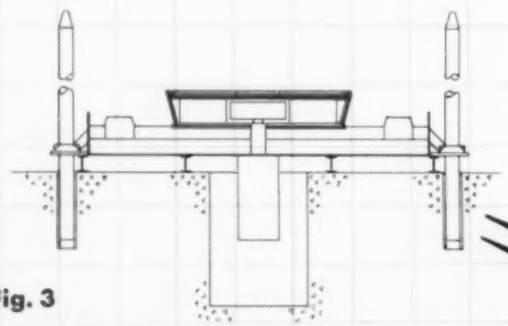
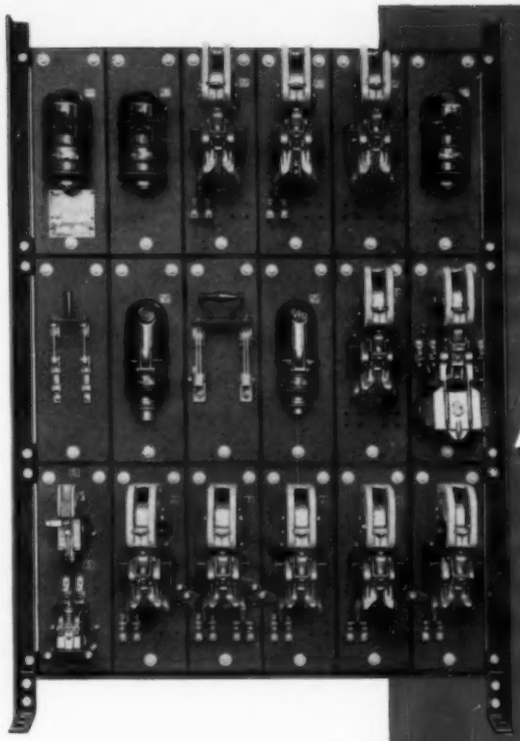


**Fig. 3**

**The Lee Wilson Portable Base Single-Stack System is today's most efficient annealing process—*write for fully illustrated booklet* that completely explains this amazing new idea of sheet and strip coil annealing.**



LOOK for these NAMES when buying Motor Control

1 LINE-ARC Contactors
2 TIME-CURRENT Acceleration (D-c)
3 FREQUENCY RELAY Acceleration (A-c)
4 WRIGHT CIRCUIT Hoist Control (D-c)
5 YOUNGSTOWN Hoist Limit Stops
6 TYPE WB Brakes
7 CAM Master Switches
8 MANUAL-MAGNETIC Disconnect Switches
9 CONTRA-TORQUE Hoist Control (A-c)
10 TAB-WELD Resistors

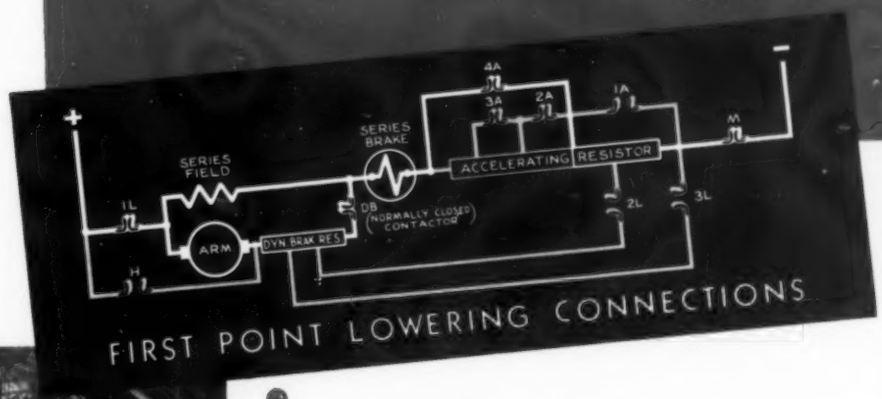
These FUNCTIONAL NAMES Speak for Themselves

# WRIGHT DYNAMIC-LOWERING CIRCUIT for D-c CRANE HOISTS

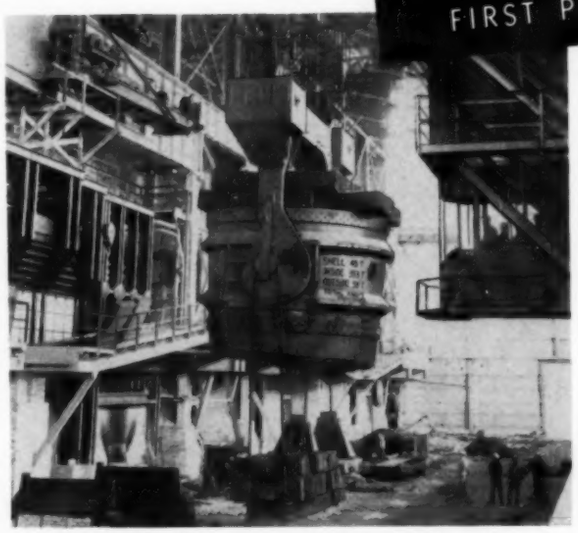
# The Wright Circuit is SAFE

Provides more accurate handling because simplified controller gives fast response.

All lowering points under direct control of the operator.




FIRST POINT LOWERING CONNECTIONS



460-Ton test load successfully handled on this 300-Ton Ladle Crane, equipped throughout with EC&M Control.

Highly regarded for its trouble-free, high output performance, the EC&M Wright Circuit HOIST Controller provides safe, accurate raising and lowering of all loads.

In the hoisting direction, the first point gives slow speed for contacting and starting light loads up without jar. In the down direction, the first point lowering connections, shown above, give quick response for accurate spotting of all loads. Note that *all* the current taken from the line goes through the brake coil for fast brake release. Also, the operator has direct control (from the Master Switch) of all loads in the lowering direction.

When buying cranes, specify the EC&M Wright Circuit Hoist Controller.

**THE ELECTRIC CONTROLLER & MFG. CO.**
**2698 EAST 79TH STREET • CLEVELAND 4, OHIO**

# New *Life-Line* Safety Switch

# Stands up...Stands out!

## *FULL LINE—FOR EVERY APPLICATION*

Looking for a chance to cut idle machine time and unpredictable maintenance load? Here's a performance-proved opportunity—with the newly strengthened, newly styled Westinghouse Life-Line Safety Switch.

For two reasons. First, precise and positive action protects your circuits and equipment when emergency demands it. MICARTA® crossbar, now 50% to 100% stronger, assures unit action of contact blades and follow-through action of the operating mechanism.

Second, Westinghouse Switches are long lived—diamond-pointed break jaw and extended blade eliminate burning of contact areas. "De-ion®" Arc Quenchers suffocate arcs in a twinkling. One-piece copper construction means fewer current-carrying joints and loose connections, resulting in less wattage loss.

Whether fused for circuit protection or unfused as a disconnect, there is a complete line of safety switches in types A, C and D for NEMA Type 1 applications.

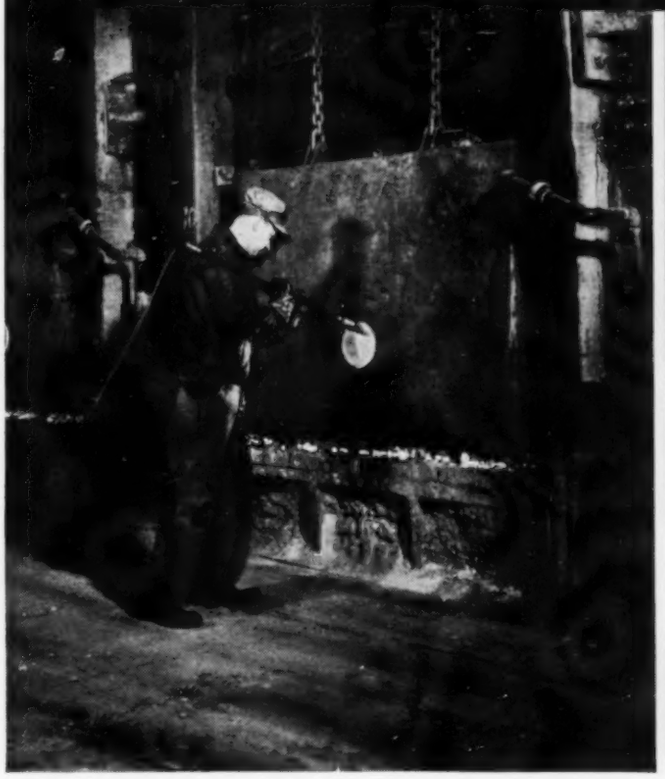
Your Westinghouse Distributor will be glad to help you. Or write for Booklet B-5457, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Penna.

J-30083

YOU CAN BE SURE... IF IT'S
Westinghouse
*Life-Line*
SAFETY SWITCHES

# FOR MORE INGOT TONNAGE PER HEAT

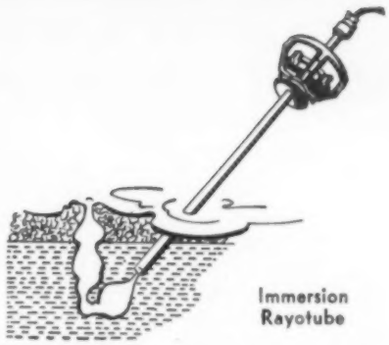
## Measure Temperatures By Immersion Thermocouple or Immersion Rayotube



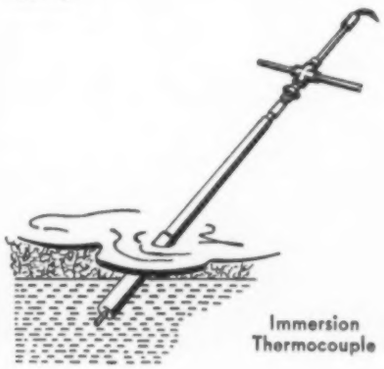
OPEN HEARTH and electric furnace shops can now choose between two tested L&N methods for measuring steel temperatures during the melt. Either an Immersion Rayotube or an Immersion Thermocouple is plunged momentarily beneath the surface to measure the temperature of the bath, while a dependable Speedomax Recorder displays the information where all concerned can use it.

Either method helps improve ingot production by warning if the steel is too hot or too cold for tapping. Recently published talks before national steel associations indicate that production losses have been sharply cut in plants where temperature is properly measured while the melt is finished off for tapping.

It pays to select your immersion-measuring equipment from a source which makes both radiation and thermocouple types. The two equipments cost about the same initially; among the factors which should be weighed without prejudice are: size and type of furnace, type and quality of steel, experience of helpers in using instruments, supervisory set-up and the differences in maintenance supplies and labor. If you'll contact our nearest office, or 4942 Stenton Ave., Philadelphia 44, Pa., we'll be glad to supply such other information as you desire.




Rayotube gets its reading inside a bubble blown by compressed air or other gas, while Thermocouple contacts the metal directly. Both methods give the "heart" temperature of the molten steel, and give it in time for any changes necessary before tapping.

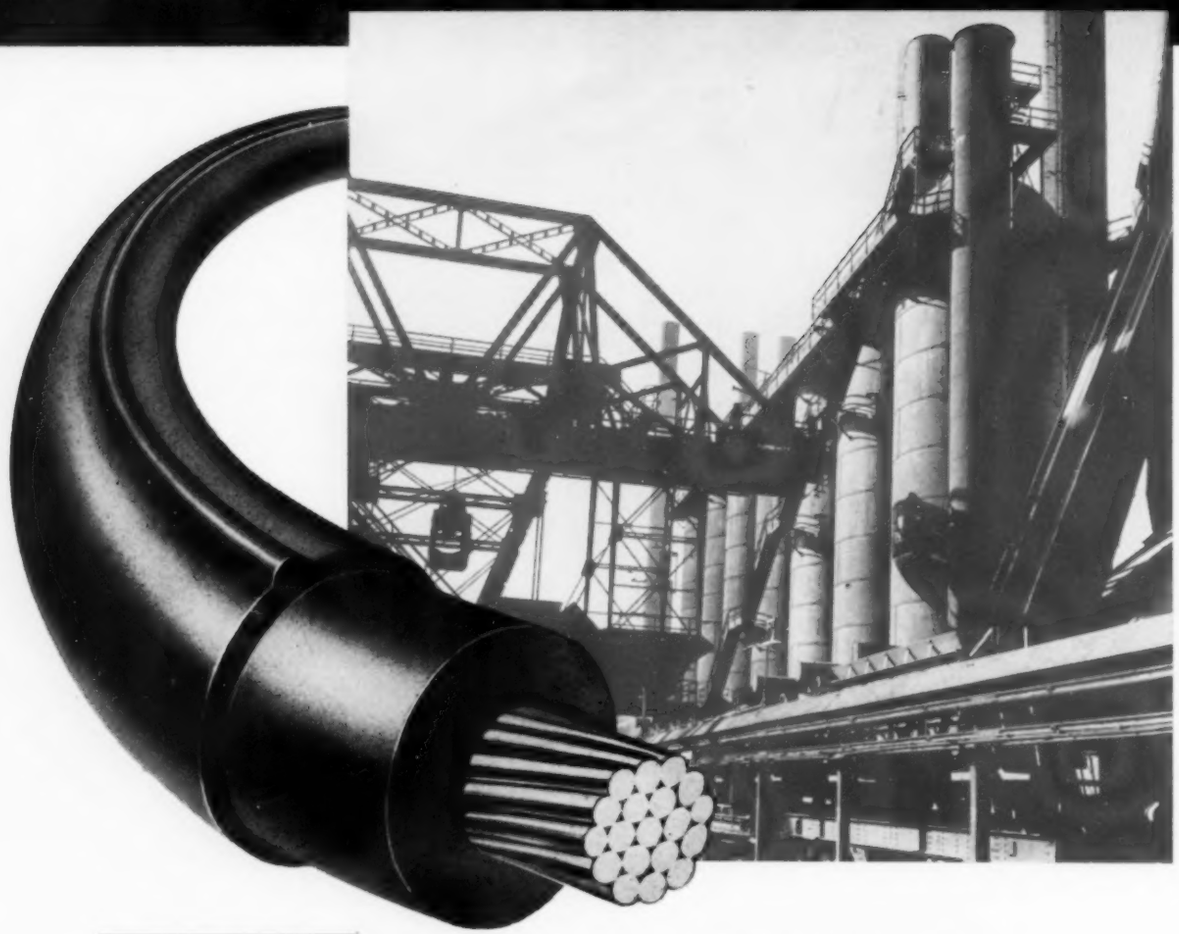



MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl. Ad. ND46-33B-0661(1)

# OKOLITE-OKOPRENE ELECTRICAL CABLE...



## proved in the steel industry for long, trouble-free service

Only a cable specifically built to withstand the heat, moisture, oils, acids and abrasive conditions in steel mills can be installed with confidence in mill power circuits. Okolite-Okoprene cables are built that way, and have been proved for power and control wiring in mills throughout the U. S.

Their basic electrical insulation is Okolite, the moisture-resisting rubber compound being used so successfully on 35,000 volt submarine cables. Their outer protection is tough Okoprene that won't rot or deteriorate. This neoprene sheath withstands high temperatures and is highly resistant to chemicals, oils, flame, mechanical damage, and any degree of moisture.

Both sheath and insulation, applied by Okonite's famed strip process, are bonded together during vulcanization in a metal mold. Only Okonite uses this precision method of manufacture in regular production.

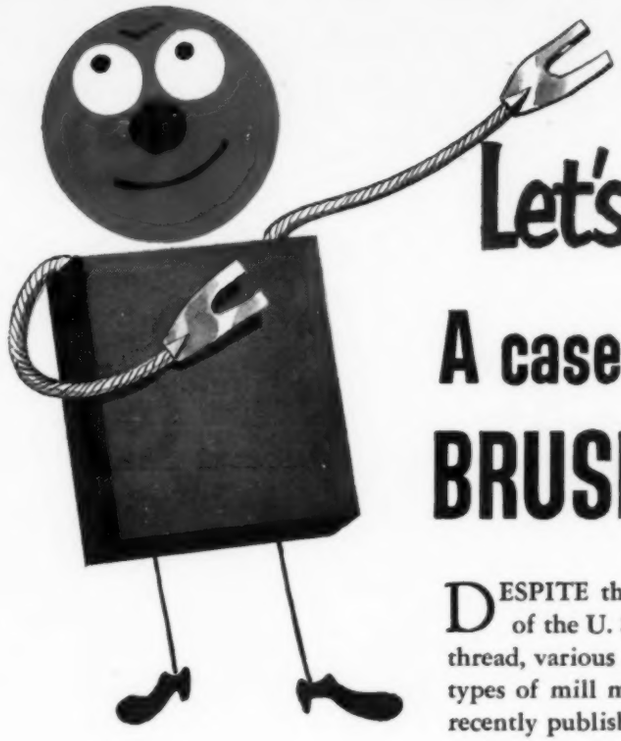
To provide extra insurance against circuit outages, Okolite-Okoprene cables are shipped out only after passing the most severe a-c and d-c tests used in the industry.

Your Okonite representative can show you how Okolite-Okoprene cables will add years of service to your power circuits. Call him in today; or write for Bulletin IS-1053. The Okonite Company, Passaic, N. J.

*The best cable is your best policy*

**OKONITE** OKONITE SINCE 1878 *insulated wires and cables*

9674



# Let's all get together...

## A case for further BRUSH STANDARDIZATION

DESPITE the fact that practically every component and sub-assembly of the U. S. industrial machine is today as STANDARD as the Acme thread, various mill operators still stock and specify thousands of different types of mill motor brushes – *most* of them differing only slightly from recently published *AISE mill motor brush standards.*

Long aware of the advantages of brush standardization, National Carbon Company offers a brush to match every one of the AISE mill motor brush standards – plus the further advantages of *shipment from stock* for all the commonly used types.

"National" STANDARDIZED Mill Motor Brushes (listed at left) come to you at the same low unit price for 100 or 100,000 brushes, sturdily packaged for convenient handling and storage.

We're off to a good start. Let's *keep going together* – toward *further* standardization and more economical, efficient operation for YOU!

**AISE standard numbers for "NATIONAL" standardized Mill Motor Brushes**

| NC NUMBER | AISE STANDARD NUMBER |
|---|---|
| 20-4800 | STD NO. 21 |
| 20-5600 | STD NO. 25 |
| 24-4800 | STD NO. 29 |
| 24-5600 | STD NO. 30 |
| 24-6400 | STD NO. 32 |

**Write for CP-2444—a complete list of "National" Mill Motor Brushes built to AISE standards.**

*The terms "National", "Eveready" and the Three Pyramids device are registered trade-marks of Union Carbide and Carbon Corporation*

**NATIONAL CARBON COMPANY**
**A Division of Union Carbide and Carbon Corporation**
***30 East 42nd Street, New York 17, N. Y.***
*District Sales Offices:* Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
IN CANADA: National Carbon Limited, Montreal, Toronto, Winnipeg

***WHY BUY THIS ITEM?***

It gives you double the usable light!
No metal can to leak or corrode!
It can't stick, swell or jam!
It delivers the whitest, brightest light!

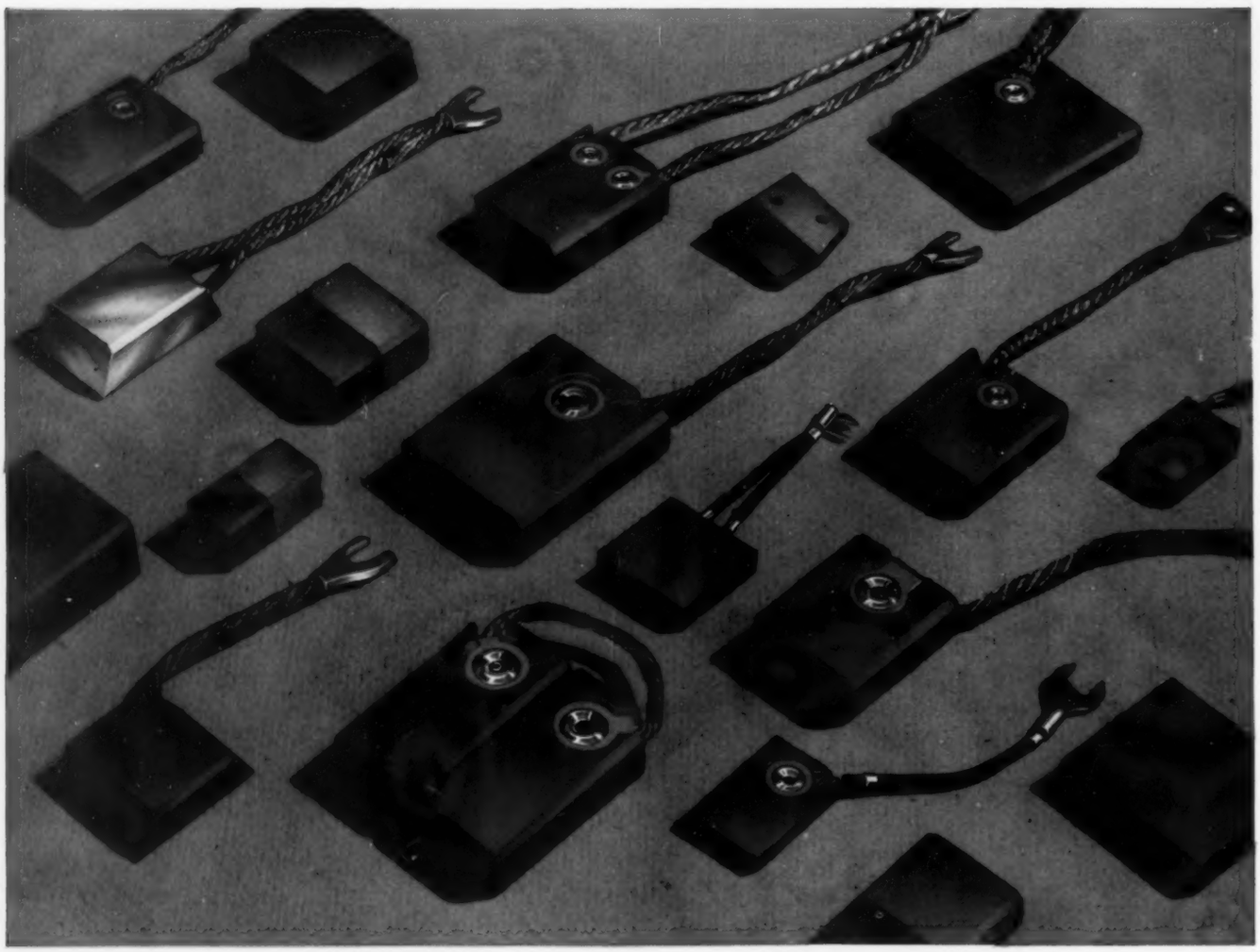
It's the "Eveready" No. 1050 flashlight battery, made with the zinc electrode inside a carbon jacket – just the reverse of every other battery on the market!

Test it and . . . you always buy it!

# BUY USG BRUSHES

Try USG Brushes. They will solve those tough application problems for you. • Complete manufacturing facilities, plus continuous research and engineering make USG Brushes and Contacts the best you can use on all rotating electrical equipment. • USG BRUSHES can do a *better* job for you . . . Let us arrange a performance test to prove it.

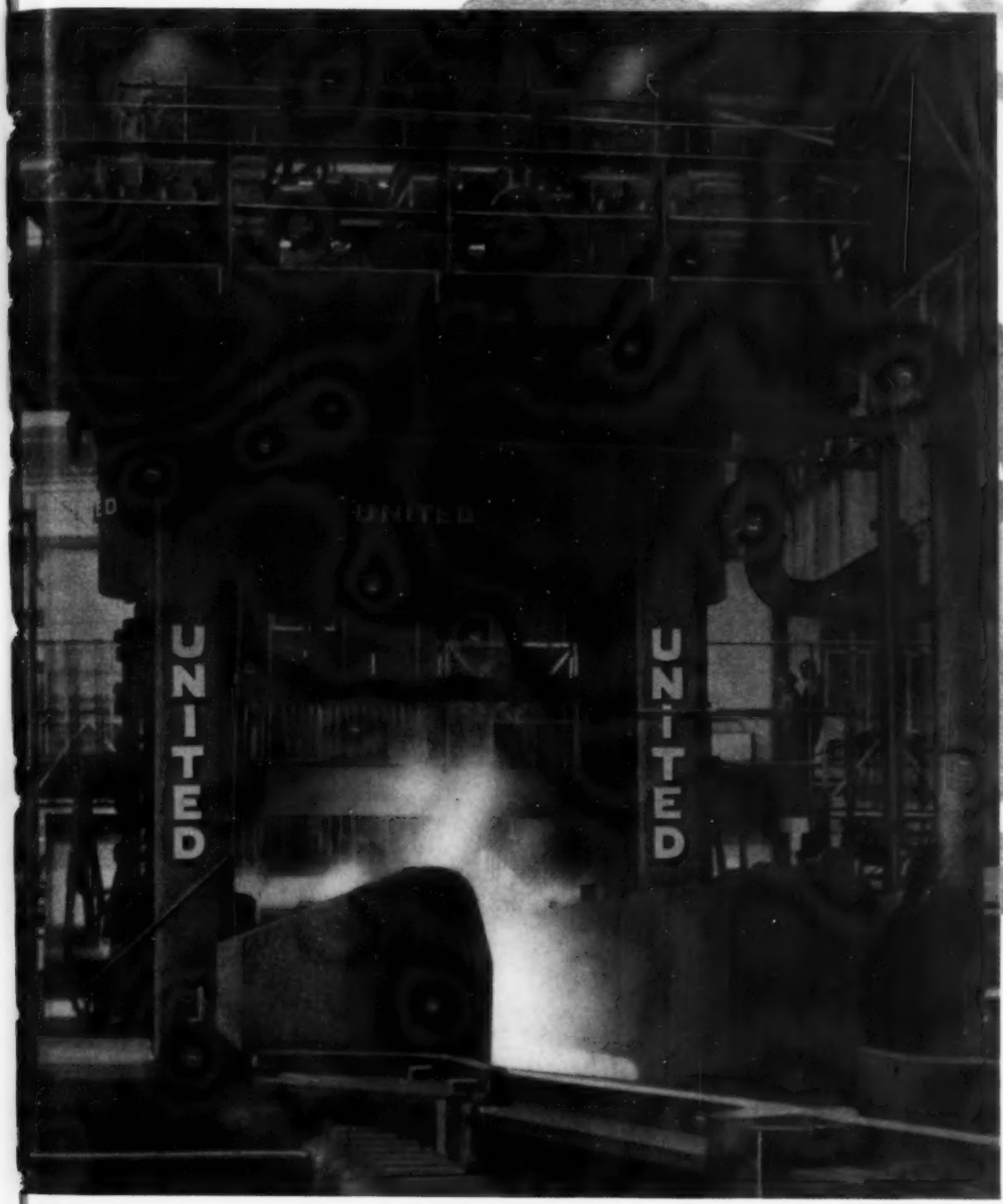
*Write today for 40-page catalog giving complete information on standard USG grades.*



90-B

## THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN




45" X 115" SLABBING MILL

**UNITED MILLS**

*the world over — wherever steel is rolled*

# UNITED

## ENGINEERING AND FOUNDRY COMPANY

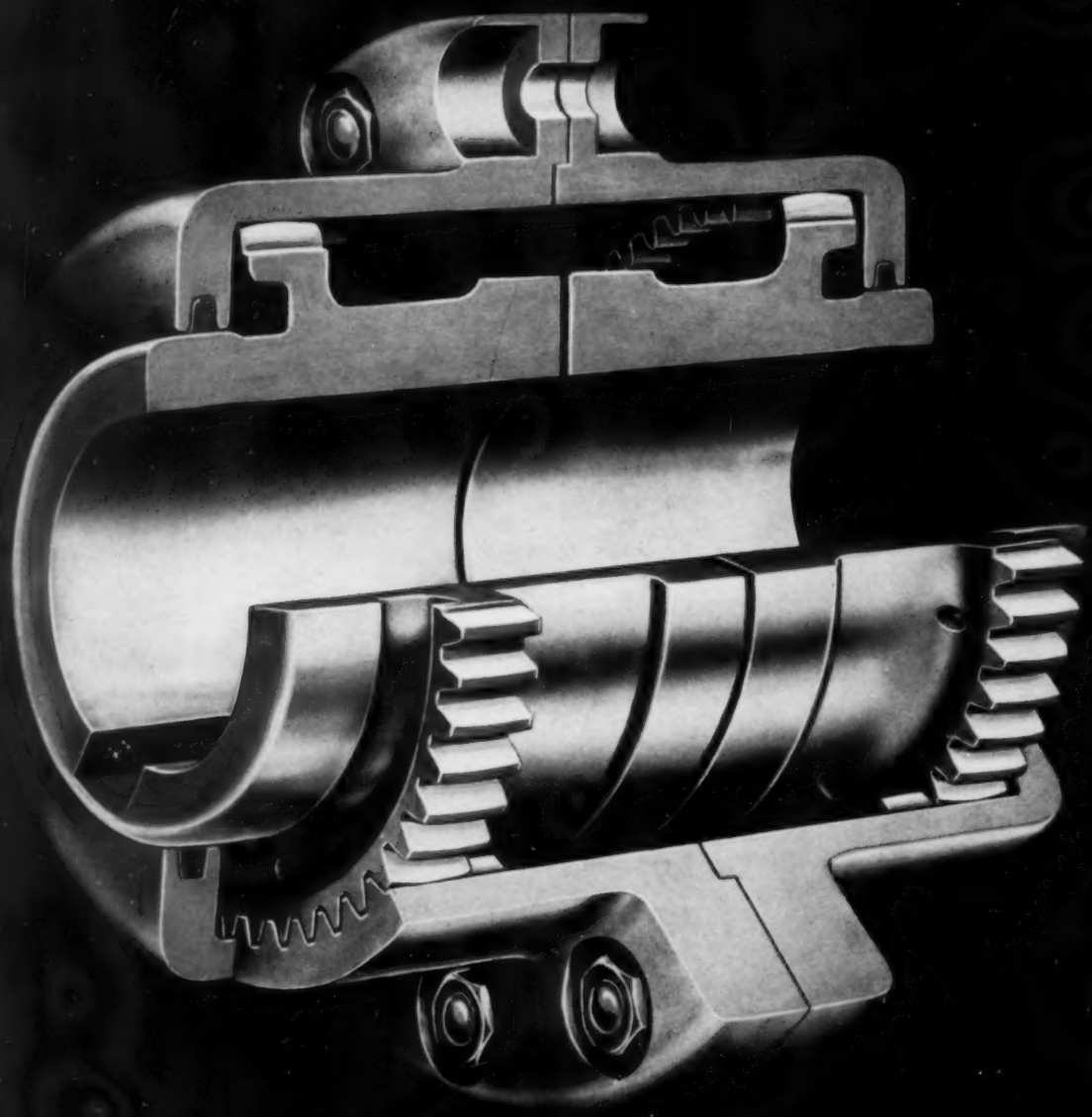
**PITTSBURGH, PENNSYLVANIA**

**Plants at:** PITTSBURGH • VANDERGRIFT • NEW CASTLE • YOUNGSTOWN • CANTON

**Subsidiaries:** ADAMSON UNITED COMPANY, AKRON, OHIO
LOBDELL UNITED COMPANY, WILMINGTON, DELAWARE
STEDMAN FOUNDRY AND MACHINE CO., INC., AURORA, INDIANA

*Designers and Builders of Ferrous and Nonferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other Heavy Machinery. Manufacturers of Iron, Nodular Iron and Steel Castings, and Weldments.*

# POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

# FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

# New straightener eliminates guides with unique roll arrangement

## *...gets trouble-free operation with TIMKEN® bearings*

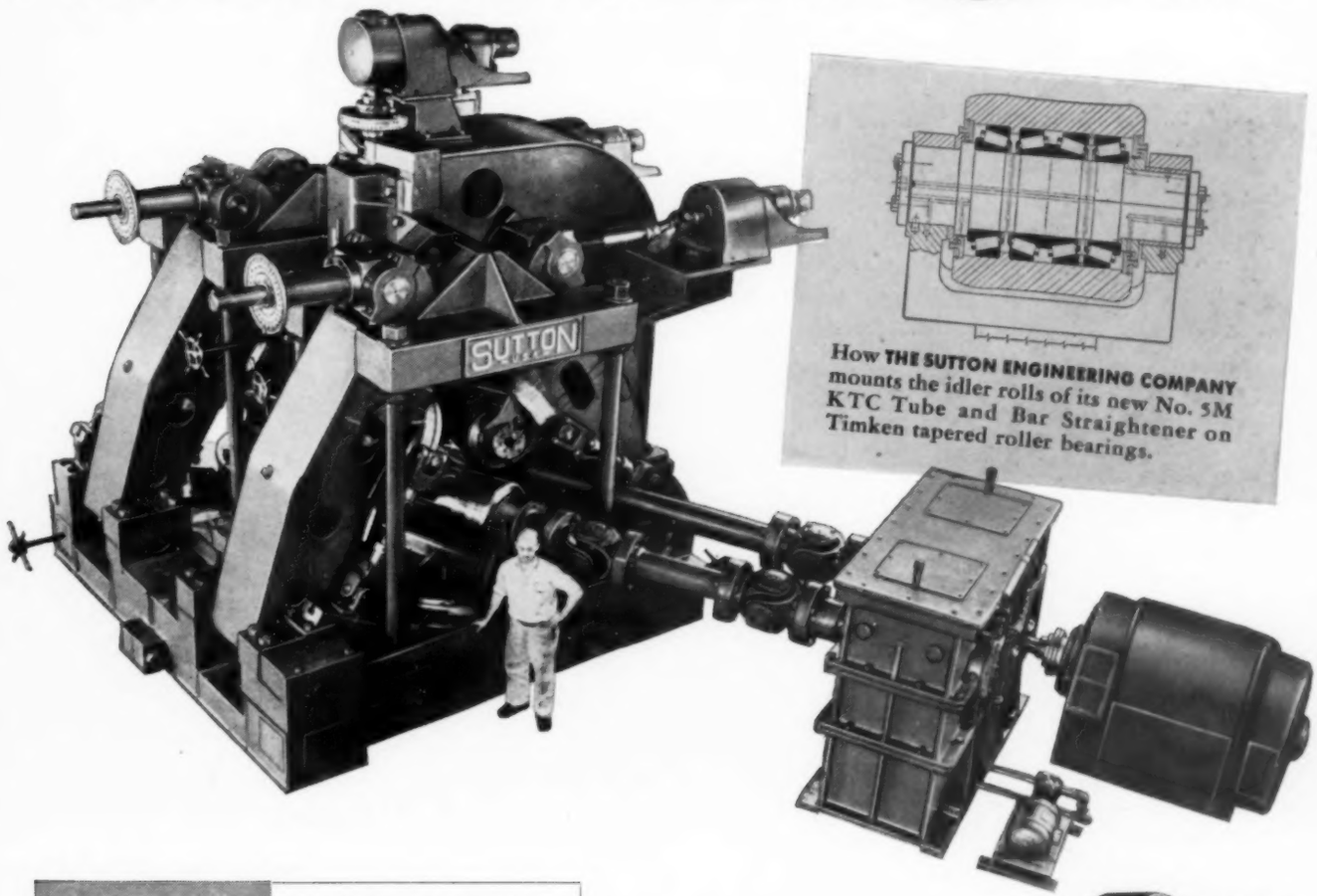
THIS new Sutton No. 5M KTC Tube and Bar Straightener has a unique roll arrangement that eliminates the use of all guides, confines the bar or tube to the pass line throughout the straightening operation. Positive feeding and uniform straightening are assured. It will straighten tubes up to 16½" O. D. and bars up to 9" O. D. To help keep the unit on the job with minimum time-out for maintenance and repairs, Sutton uses a total of 43 Timken® tapered roller bearings in the driven rolls, idler rolls, drive unit and universal joints.

The Timken bearings in this new straightener have load capacity to spare, due to line contact between the rollers and races. Because of tapered construction Timken bearings take both radial and thrust loads, hold rolls and shafts in proper alignment, reduce wear on moving parts.

Sutton has found that closures are more effective because Timken bearings keep housing and shaft concentric. Dirt and moisture are kept out—lubricant is kept in. Maintenance and lubrication time are cut to a minimum.

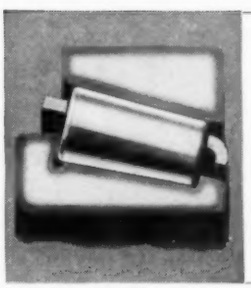
No other bearing can give you *all* the advantages you get with Timken tapered roller bearings. Be sure you specify them for all the equipment you build or buy. Look for the trademark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

*This symbol on a product means its bearings are the best.*






How **THE SUTTON ENGINEERING COMPANY** mounts the idler rolls of its new No. 5M KTC Tube and Bar Straightener on Timken tapered roller bearings.



**GREATER LOAD AREA**

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

**TIMKEN**

TRADE-MARK REG. U. S. PAT. OFF.

**TAPERED ROLLER BEARINGS**

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION ✳

# POWER + PRECISION

Another example of the ability of Morgan engineers to design to suit your requirements is this new edging mill.

This vertical mill has the power and rigidity for heavy reductions and the precision required for light edging. The overhead pinion drive with slidable spindles simplifies uncoupling the rolls for roll changing. The bottom wedge adjustment permits quick and accurate pass alignment. The housings are hydraulically traversed with the additional feature of fine screw adjustment through the twin yokes. The complete unit is so designed that no water or scale can enter the housings.

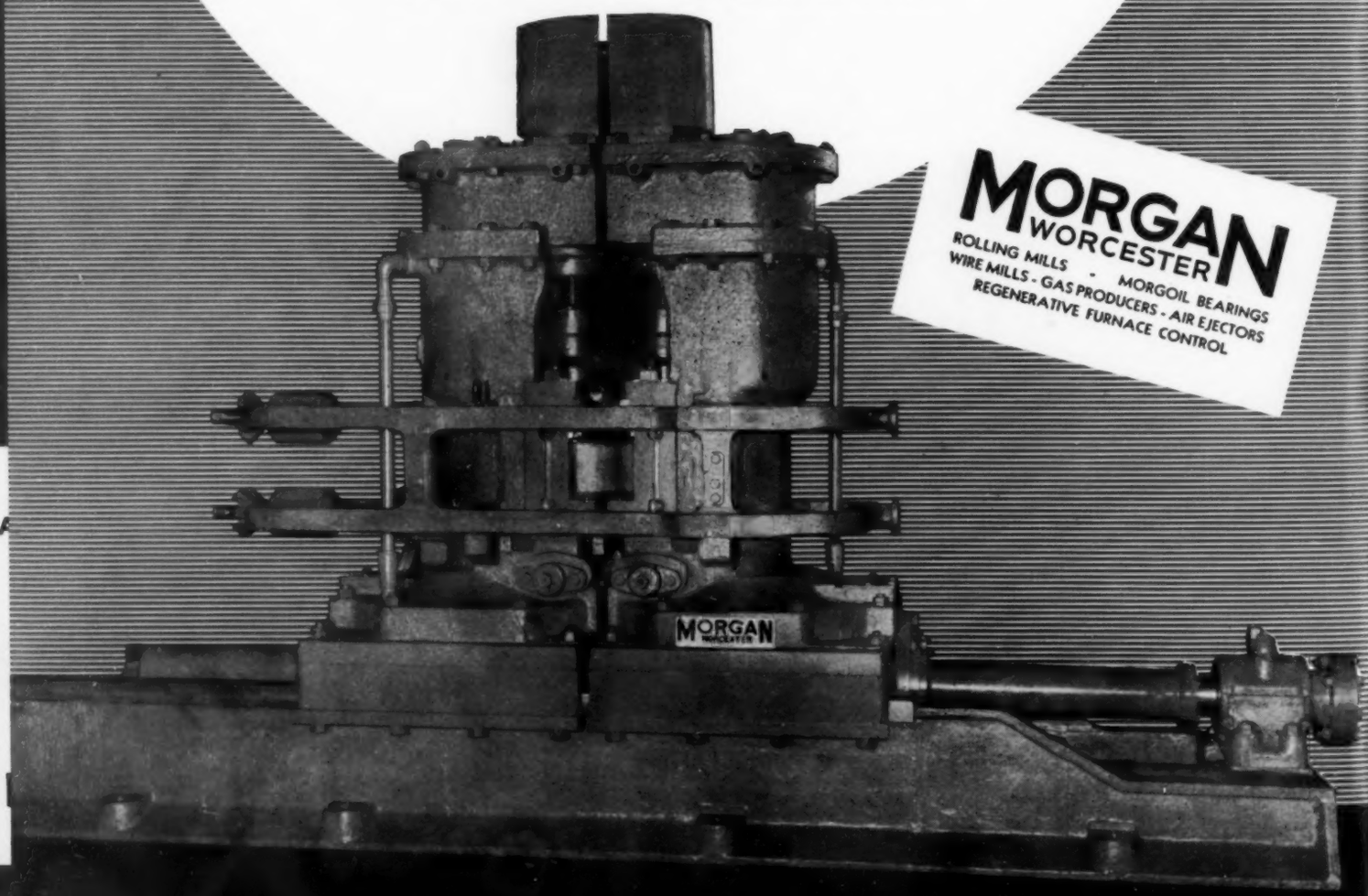
Why not discuss *your* mill problem with our engineers?

RM-44

## MORGAN CONSTRUCTION CO.

**WORCESTER, MASSACHUSETTS**

*English Rep.*, International Construction Co., 56 Kingsway, London W. C. 2, Eng.




**MORGAN**
WORCESTER

ROLLING MILLS - MORGOIL BEARINGS
WIRE MILLS - GAS PRODUCERS - AIR EJECTORS
REGENERATIVE FURNACE CONTROL

# FARRELL-CHEEK CRANE WHEELS

## ALLOY CAST STEEL

FARRELL-CHEEK crane wheels can be supplied to suit your exact requirements. Controlled heat treat, a completely modern plant, selected alloys, and thorough research by our staff of engineers, produces wheels which give service from four to eight times greater than ordinary wheels.

Wherever wheels receive day-in and day-out heavy use . . . such as on charging machines, ingot buggies, skip hoists, or on transfer and kiln cars . . . Farrell-Cheek provides the best wheel for the purpose, and best with Farrell-Cheek means minimum wear, long life and thoroughly satisfied users.

Farrell-Cheek wheels are made to be highly resistant to shock loads and to abrasive wear. They have earned their fine reputation by giving maximum, trouble free service on the job. All wearing surfaces are carefully hardened of the finest of pressure cast steels. Endurance, freedom from frequent change over, economy and safety are all inherent in any Farrell-Cheek wheel.

**Farrell-Cheek's one-point service is truly complete. Either standard or special designs can be furnished. Our engineering department will gladly design according to your needs and specifications. Farrell-Cheek Steel Company has earned a fine reputation for its ability to provide the best product for your use.**

**WE WOULD BE HAPPY TO SERVE YOU**

## SKIP, INGOT CAR, GANTRY, MONORAIL, CHARGING MACHINE

**F-"85"**

F-"85" is a special purpose cast steel which can be heat treated through selective processing. Treads and flanges are toughened and hardened for maximum resistance to shock and abrasive wear.

**HARD EDGE**

Farrell's Hard Edge cast steels produce wheels in which treads and flanges are processed and treated through a depth of from 1-8" to 5-16", according to the size of the wheel. This extremely tough, hardened surface is backed with alloy steels having a Brinell rating of from 285 to 315. All Farrell wheels are supplied with either straight, tapered, or radius-[illegible] treads, [illegible] finished

# FARRELL - CHEEK STEEL CO.

**MANUFACTURERS OF HIGHEST QUALITY ELECTRIC FURNACE CARBON AND ALLOY STEEL CASTINGS**

**FARRELL'S CARBON STEEL CASTINGS**
**FARRELL'S HARD EDGE STEEL CASTINGS**
**FARRELL'S "85" STEEL CASTINGS**

**RAILROAD CASTINGS**
Locomotive and Car
R. R. Specialty Castings.

**ELEVATOR, CONVEYOR PARTS**
Sprockets, Traction Wheels, Chains, Buckets, Rollers, Idlers.

**BUSHINGS**
Carbon and Alloy Steels Machined, Hardened, Ground.

**CRANE WHEELS**
Overhead, Gantry, Monorail, Ingot Car, Charging Machine.

**GEARS AND PINIONS**
"True Tooth" Gears and Pinions, Sheaves and Wheels.

**SPECIALIZED CASTINGS**
Light Section Castings.

**STOKER PARTS**
Feed Screws, Furnace Tools, Flanged Pipe, etc.

**HEAVY HARDWARE**
Wire Rope Fittings, Choker Hooks, Bar Benders, Cutters.

YOUR INQUIRY WILL PROMPTLY BRING DETAILED INFORMATION PERTAINING TO ANY OF THE ABOVE FARRELL-CHEEK PRODUCTS

**SANDUSKY, OHIO U.S.A.**

**Continuous sintering** in this plant begins with storage bins, each holding a different material. Feeders discharging from bins to conveyor are group-driven by co-ordinated G-E 5-hp adjustable-speed d-c motors, which keep individual feeders in correct speed relationship, assure uniform mixture at all times regardless of line's speed.

**After actual mixing** in two pug mills, mixture goes to sintering machine. This G-E 1000-hp synchronous motor drives sintering fan which draws air over charge. Fan, located outside building, is connected through wall at right.

# G-E sintering-line drives maintain uniform mixture, continuous flow!

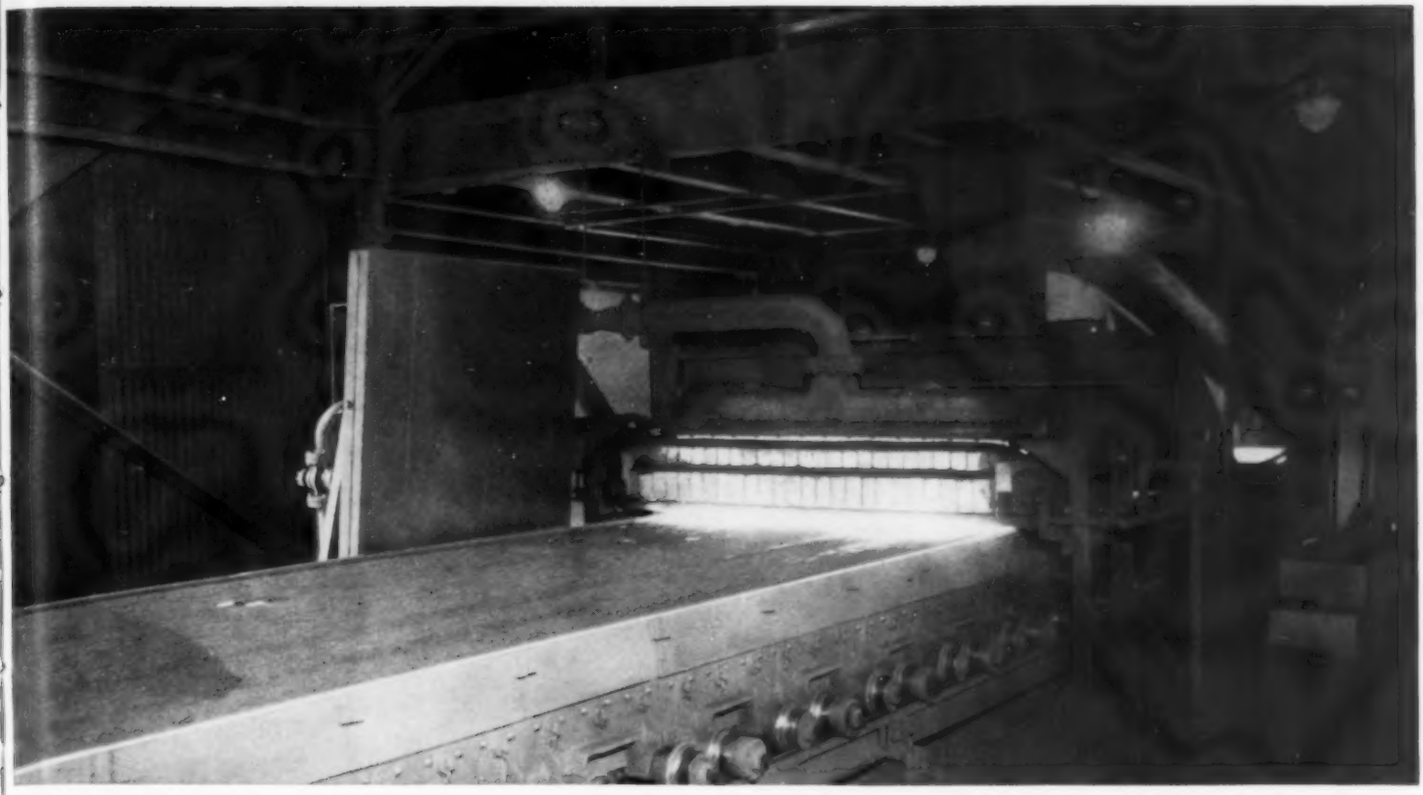
## Centralized control of co-ordinated drives in G-E equipped plant keeps individual feeders in step, helps assure 3000-tons-per-day output!

Maintaining the correct proportion of materials to be blended in a modern continuous sintering line is an easy matter—with co-ordinated G-E group drives. That's the case at this large steel mill, where they were supplied as part of an all G-E engineered job for a new sintering plant. These drives keep individual feeders in the same speed relationship to each other at all times, regardless of changes in the sintering line's speed. Result: the mixture is always right, and production keeps moving to the tune of 1500 tons per day for each of the plant's two sintering lines.

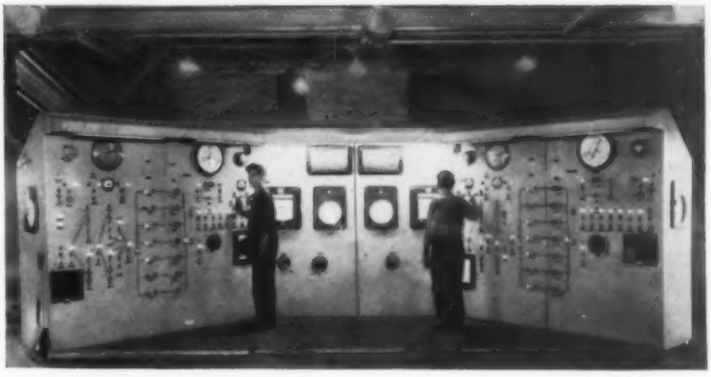
Working closely with machinery manufacturers who supplied the processing equipment, G.E. co-ordinated the entire electrical system from start to finish, saved the plant's operators time and effort, helped get production started without needless delays.

*Your* drive problems, too, can be solved just as successfully by calling in G.E. to work with your engineers and equipment suppliers. A G-E steel-mill specialist will gladly show you how. Call him at your nearest G-E office. *General Electric Company, Schenectady 5, New York.* 659-84

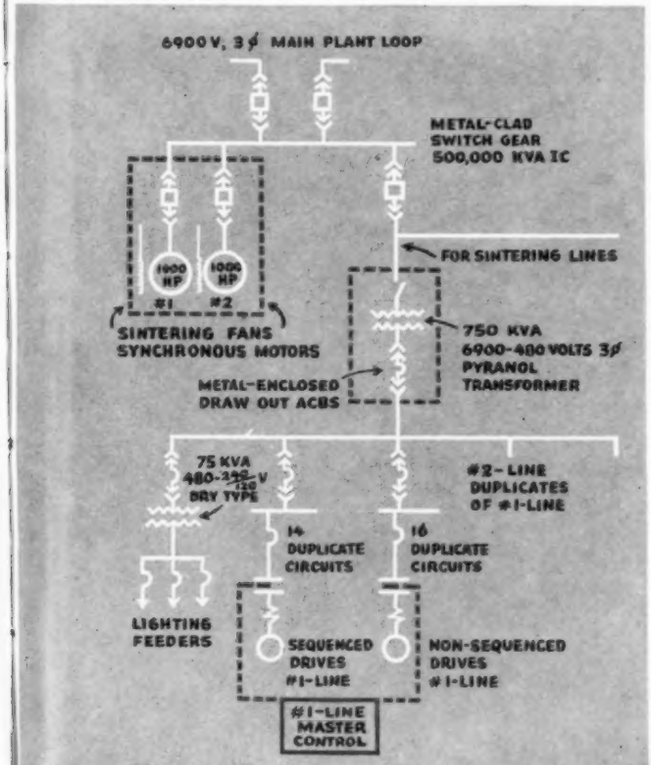
GENERAL ELECTRIC



**Heart of the process** is this sintering machine, driven by a G-E 15-hp adjustable-speed d-c motor. Swinging spout at far end deposits mixed material in layers on machine's traveling grates. Mixture is then ignited as it goes through an ignition burner, and burned on the grates as they move left. Sintering action is timed for completion at discharge end.



**Centralized control** of plant's two sintering lines is provided by this G-E master operator's panel. Included are push-button stations for starting and controlling various drives, metering and indicating equipment, and interlocking control that simplifies sequence operation of units, prevents pile-ups of material.

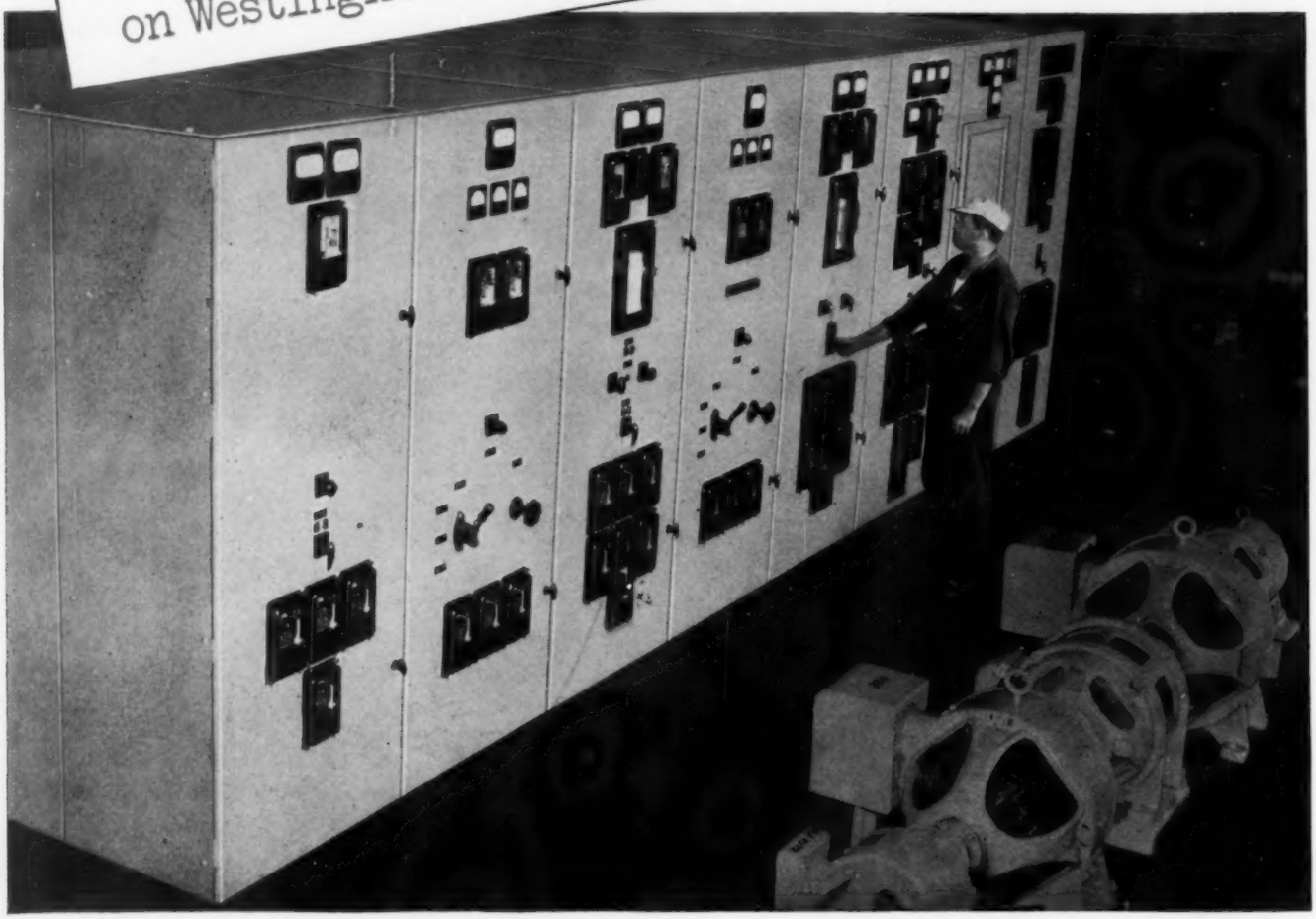

6900 V, 3 ϕ MAIN PLANT LOOP
METAL-CLAD SWITCH GEAR 500,000 KVA IC
FOR SINTERING LINES
1000 HP #1
1000 HP #2
SINTERING FANS SYNCHRONOUS MOTORS
750 KVA 6900-480 VOLTS 3 ϕ PYRANOL TRANSFORMER
METAL-ENCLOSED DRAW OUT ACBS
75 KVA 480-240/120 V DRY TYPE
#2-LINE DUPLICATES OF #1-LINE
14 DUPLICATE CIRCUITS
16 DUPLICATE CIRCUITS
LIGHTING FEEDERS
SEQUENCED DRIVES #1-LINE
NON-SEQUENCED DRIVES #1-LINE
#1-LINE MASTER CONTROL

***Here's the electrical story in brief:*** this modern sintering plant uses the unit control scheme, consisting of a master push-button control panel for remote drive control, grouped control centers that contain all motor starters, and load-center unit substations that step down primary 6900-volt power to 480-volt secondary power for smaller-hp motors. The two sintering-fan synchronous motors, each rated 1000 hp, 6600 volts, are powered directly by the incoming 6900-volt line and controlled through metal-clad switchgear.

Full-voltage starting is used to take advantage of its lower initial investment cost and easier maintenance for motors and control, as compared to the reduced-voltage method. Not shown in this simplified diagram is the raw-material-handling process, which precedes the actual sintering.

## *Another example of G-E drive engineering at work!*

Weirton Steel Company reports on Westinghouse Switchgear



# "It's Safe...Dependable...Economical!"

This attractive installation of Westinghouse Metal-Clad Switchgear serves the No. 5 Tandem Mill at Weirton Steel Company, Weirton, W. Va. It also serves this user's interests in other respects as this statement indicates:

*"Your complete factory-assembly of this unit enables us to reduce substantially normal ordering and installation costs. Less engineering time was required and the installation was made quickly and simply.*

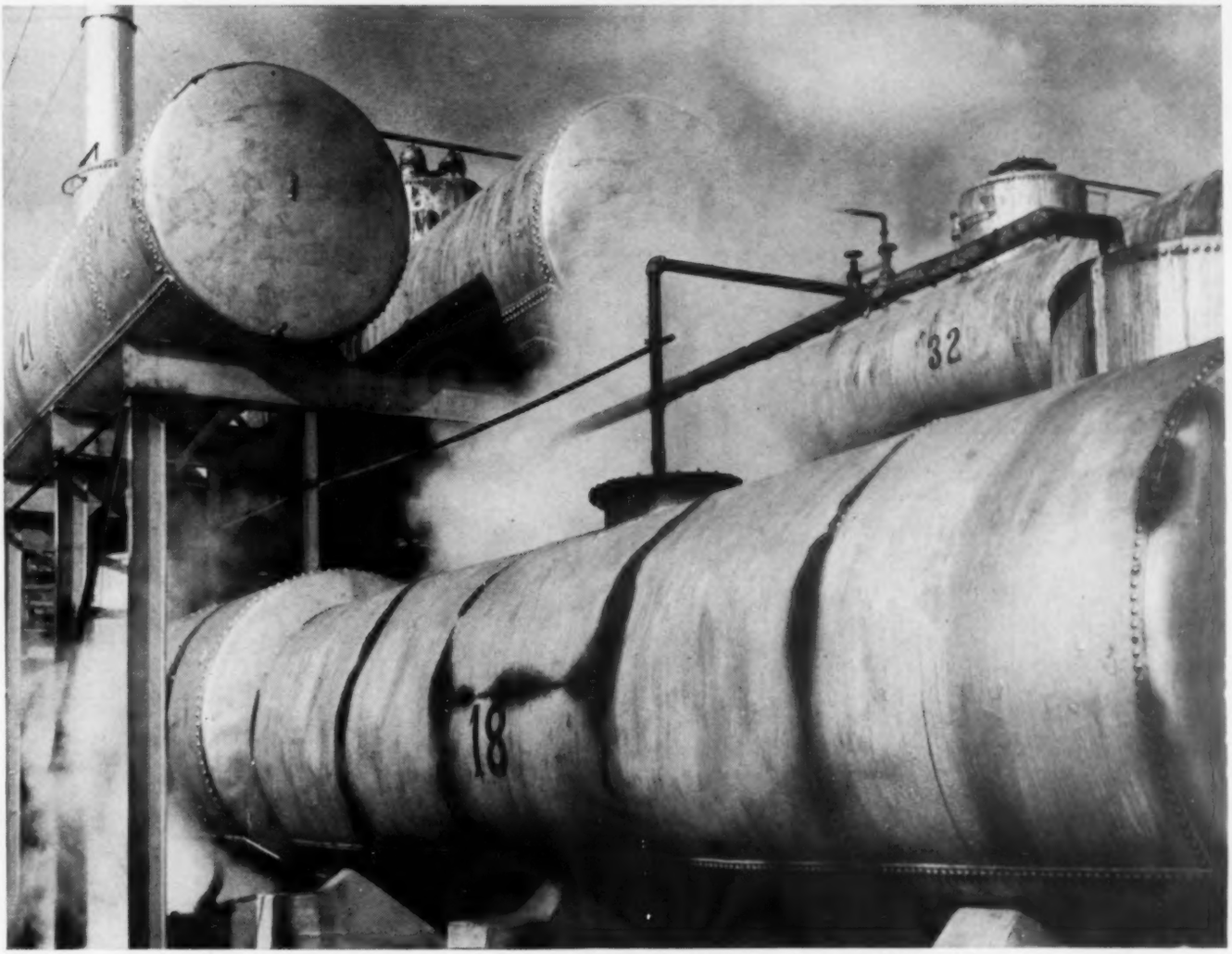
*"From a safety standpoint, we particularly like its interlocking and isolation feature which eliminates hazards in operation. The unit has been entirely reliable in service."*

Unusually low maintenance is another feature that's sure to increase this customer's satisfaction with Westinghouse Switchgear. Several important reasons—easy accessibility . . . drawout air breakers . . . exclusive "De-ion®" circuit interruption.

For complete information on Westinghouse Metal-Clad Switchgear, ask for Booklet B-4016. Contact your Westinghouse Representative or write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60773

YOU CAN BE SURE...IF IT'S Westinghouse

METAL-CLAD SWITCHGEAR




***Not half a world away . . . but right in the heart of the industry. In this battery of heated tanks, newly made Palmoshield is stored, ready for immediate shipment.***

## Buy it as you use it...

# *Palmoshield service eliminates stockpiling*

Threats of war . . . shipping uncertainties . . . materials shortages. These headaches fade away when you use Palmoshield as the essential lubricant in your rolling operations.

For Palmoshield is an all-American product made from freely available domestic materials right in the heart of the steel industry. As a Palmoshield user, you are not dependent on overseas shipment from foreign-controlled sources. So you need not tie up space or funds in stockpiling.

A call to Ironsides in nearby Columbus brings overnight shipment in emergencies. Where requirements are established, a delivery schedule can be set up which assures your receiving Palmoshield on a regular basis.

***Now tested and proved in commercial use***
Within a few months Palmoshield has been accepted by most major steel companies for on-the-job test runs or actual mill operation. Results substantiate findings in three years of pilot tests:

*—that Palmoshield duplicates every chemical characteristic of imported palm oil.*

*—that it looks, feels, acts, handles like the imported product.*

*—that it requires absolutely no changes in rolling mill operation.*

*—that it is superior to palm oil in being subject to exact chemical control. You can specify free fatty acid content to ½%—and get it.*

Palmoshield is available for immediate shipment in 55-gallon drums and in tank car lots. Competitively priced. For details write The Ironsides Company, 270 West Mound St., Columbus, Ohio.

**SPECIAL LUBRICANTS and PRESERVATIVES**

**IRONSIDES** SHIELD PRODUCTS **PALMOSHIELD**

# LEWIS ROLLS . . . . . are designed for precision production

OVER 90 YEARS LEWIS OF ROLL MAKING

"X" and "XA"

AJAX DUPLEX ROLLS

SPECIAL PROCESS ROLLS

SPECIAL TUBE MILL ROLL

CLIMAX and AJAX ROLLS

ATLAS and ATLAS "B" ROLLS

MOLYBDENUM CHILLED IRON ROLLS

The mark of the PERFECT ROLL

MANUFACTURERS OF
ROLLS AND ROLLING MILL EQUIPMENT
FOR THE IRON, STEEL AND
NON-FERROUS
INDUSTRIES

LEWIS FOUNDRY AND MACHINE DIVISION OF BLAW-KNOX COMPANY • PITTSBURGH, PA.

# STOP RUST!

## with RUST-OLEUM

Every *rustable* metal surface needs **RUST-OLEUM**—the *exclusive* formula *proved* in all types of industry, at sea, above and below ground for over 25 years! Goes on easily by brush, dip or spray . . . dries to a *firm, elastic, decorative* finish that resists salt air, rain, snow, heat, fumes, smoke, etc. **RUST-OLEUM** may be applied *directly over surfaces already rusted without removing all the rust!* Simply scrape and wire-brush to remove rust scale and loose particles. Sandblasting and other costly preparations are not usually required. So easy to use that one man often does the work of two! Specify **RUST-OLEUM** to your contractor, architect or maintenance department. Prompt delivery from Industrial Distributor stocks in principal cities.

**RUST-OLEUM CORPORATION**
**2445 Oakton Street • Evanston, Illinois**

***RUST-OLEUM BEAUTIFIES AS IT PROTECTS — AVAILABLE IN ALL COLORS, ALUMINUM AND WHITE***

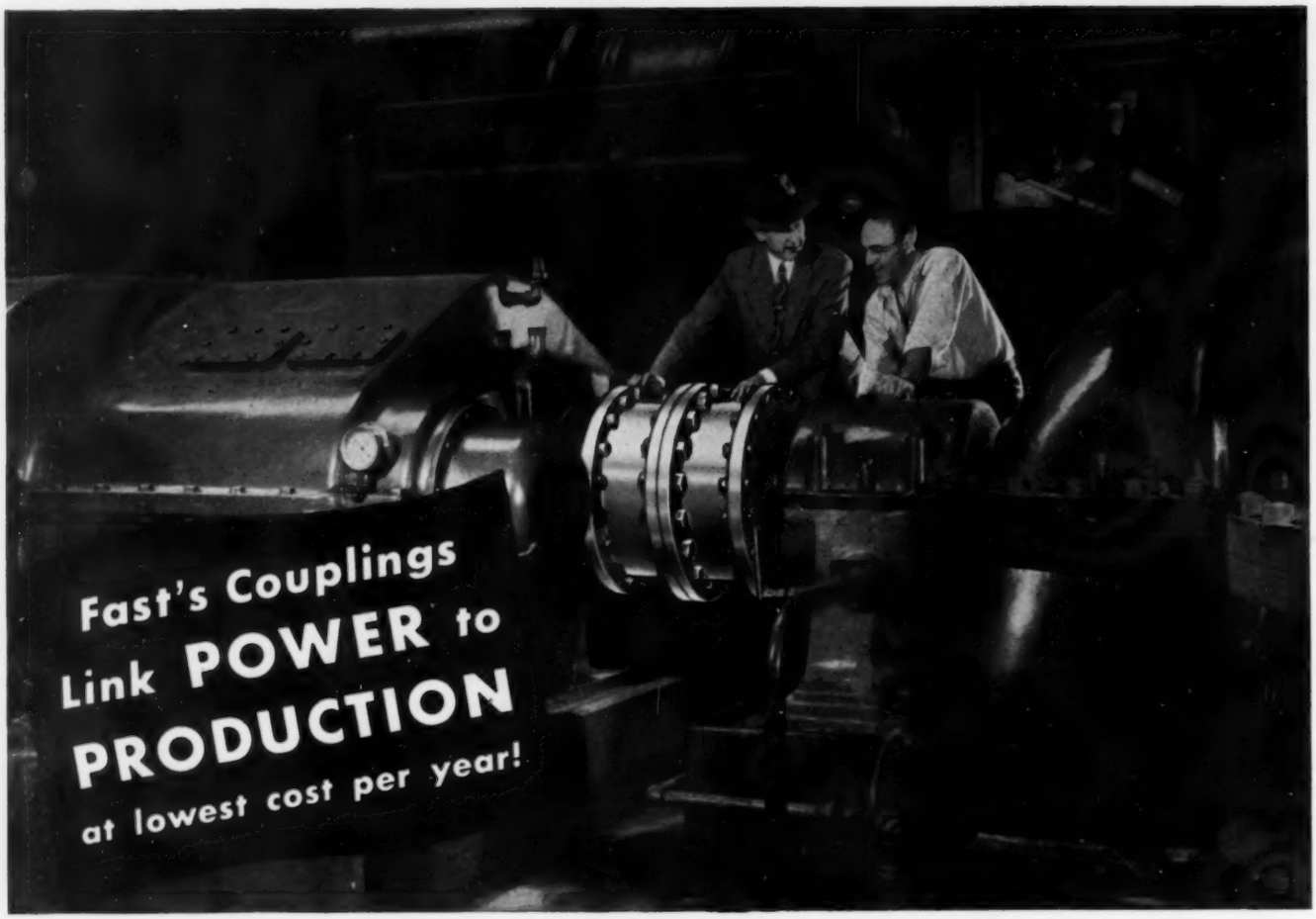



**FREE SURVEY:** Place your rust problems in the hands of a **RUST-OLEUM** specialist. He will conduct a survey, including *applications, specific tests,* and *recommendations. No cost or obligation.* See Sweets for catalog and nearest **RUST-OLEUM** distributor, or write for literature on your company letterhead.

***CLIP THIS COUPON TO YOUR LETTERHEAD MAIL TO:***

**RUST-OLEUM CORPORATION**
**2445 Oakton Street • Evanston, Illinois**

- ☐ Have a Qualified Representative Call.
- ☐ Full Details on FREE Survey.
- ☐ Complete Literature.
- ☐ Nearest **RUST-OLEUM** Source.




# Over half a million FAST'S Couplings now in use!

THROUGHOUT industry, Fast's are rated the most dependable couplings on the market . . . to the tune of over half a million now in service! Year in, year out, they continue to *outlast the equipment they connect* . . . save time, maintenance and money by eliminating costly coupling failures.

Actual cases on record show many Fast's Couplings have been in operation for 25 and 30 years without trouble. And every major producer of high-speed equipment now uses Fast's!

Solve your coupling worries! Write today for full details on Fast's Couplings and Koppers Engineering Service to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 213 Scott St., Baltimore 3, Maryland.

## Here's How FAST'S Save You Money

***Free Service***—Koppers free engineering service assures you the right coupling for the job.

***Rugged Construction***—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

***Lowest Cost per Year***—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

KOPPERS®

**FAST'S**
THE ORIGINAL
GEAR-TYPE
**Couplings**

**INDUSTRY'S STANDARD FOR 32 YEARS**

**KOPPERS COMPANY, INC.,** *Fast's Coupling Dept.*
**215 Scott St., Baltimore 3, Md.**

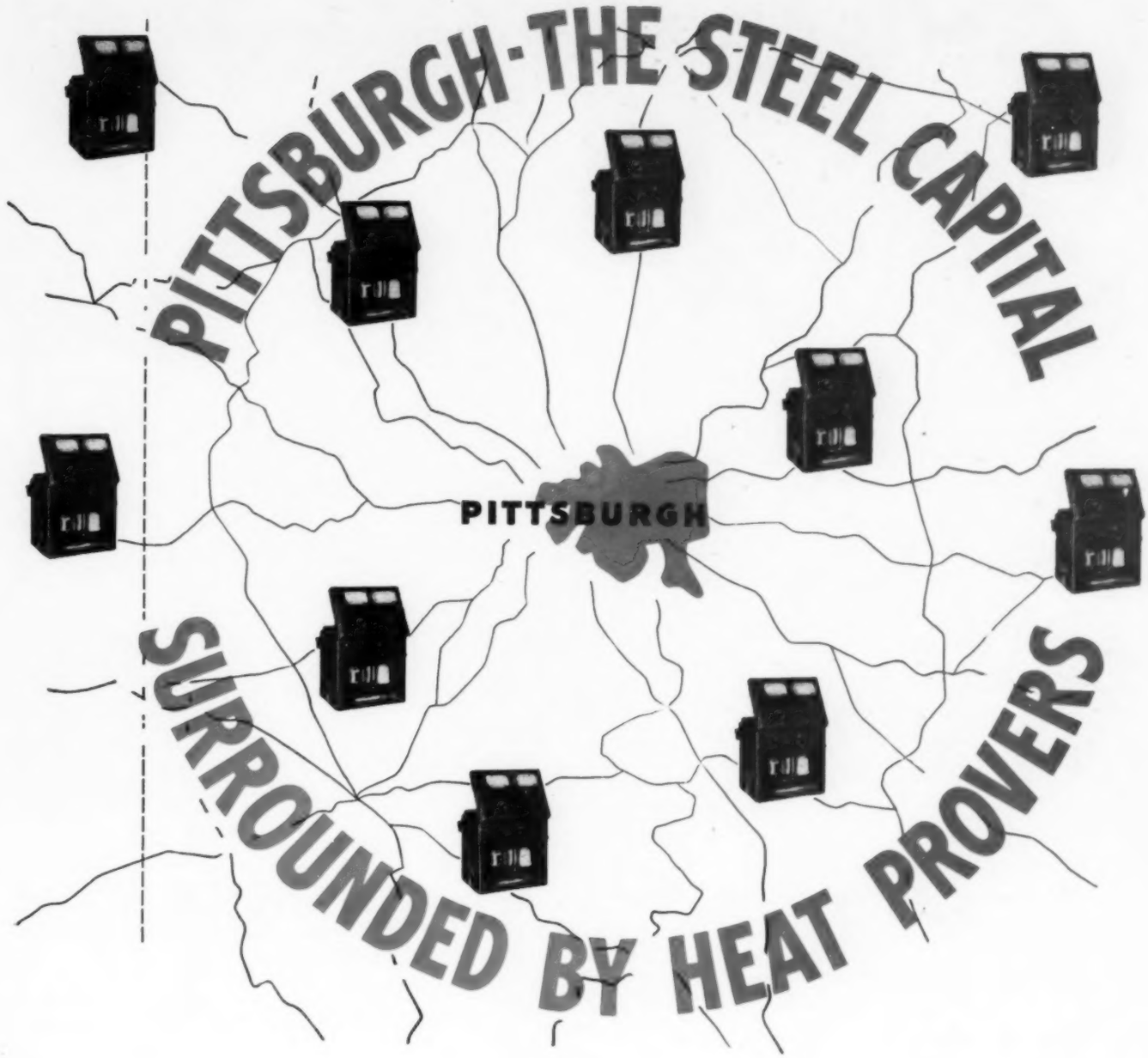
*Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.*

*Name* .....

*Company* .....

*Address* .....

*City* ..... *Zone* ..... *State* .....




When your eye is on Pittsburgh—and three dozen towns in its orbit—you're spotting scores of furnace operations regularly checked by Cities Service Heat Provers. Here, where they know all kinds of furnace instruments, and where high efficiency is most urgent today, the application of Heat Provers by Cities Service is increasingly valued.

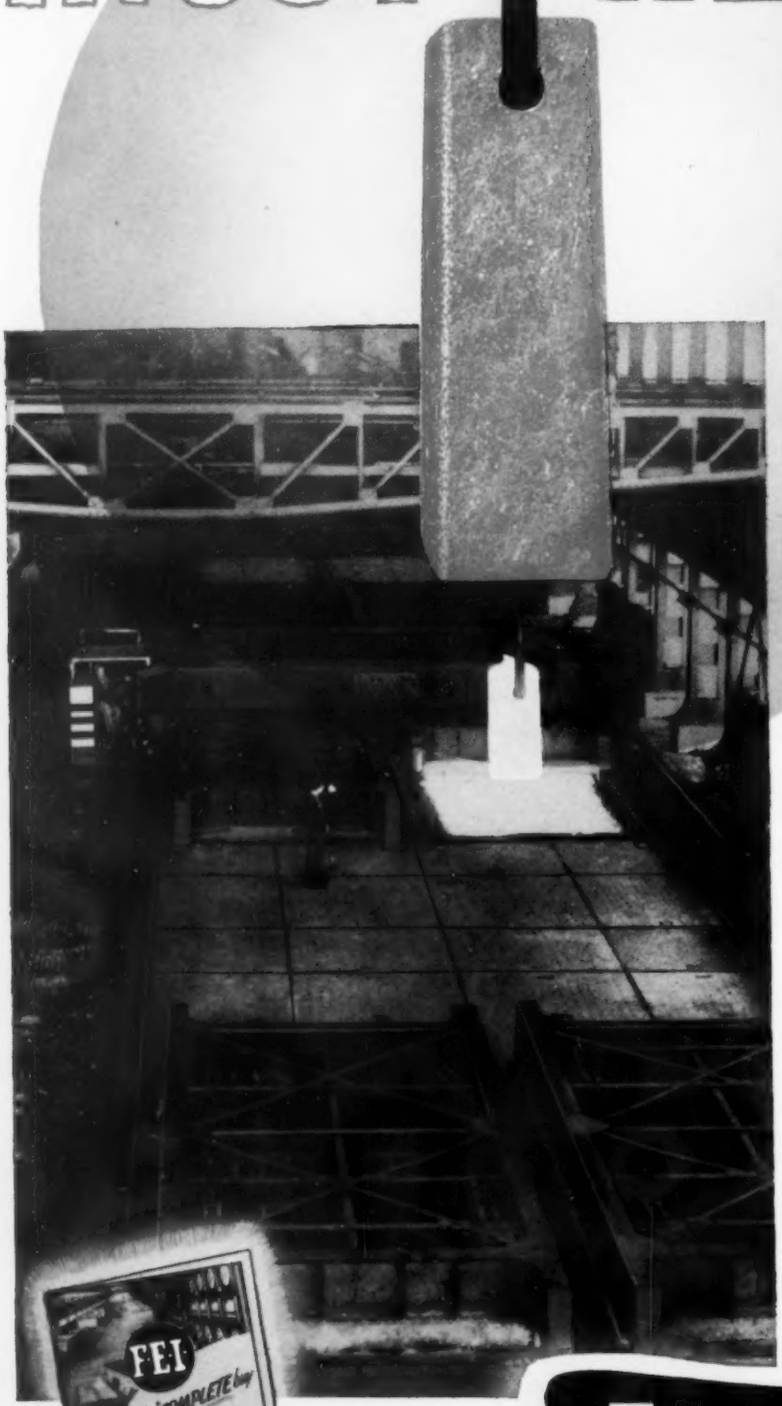
It takes the Heat Prover to read simultaneously for oxygen and combustibles, measured direct by actual gas analysis. And the Heat Prover's continuous rapid sampling reveals effects of furnace adjustments at once. The Heat Prover frees you of maintenance too, because it's *not an instrument you buy, but a Service we supply*. Learn how it can raise productivity for you . . . in iron, steel, ceramics, glass, cement or any other furnace operation. Write CITIES SERVICE OIL COMPANY, Dept. E17, Sixty Wall Tower, New York City 5.

**CITIES SERVICE**

**QUALITY PETROLEUM PRODUCTS**

*The Complete Buy* **F·E·I** *for Greatly Improved*

# INGOT HEATING



**regenerative and**

**one-way recuperative**

## *soaking pits*

- **Completely Automatic**
- **High Air-Preheat**
- **Minimum Scaling**

**MODERN TO THE Nth DEGREE . . .** Latest records show greatly increased output of ingots with minimum fuel consumption.

**FIRED BY COLD BLAST FURNACE GAS** or any other fuel. F.E.I. Soaking Pits provide extremely high preheated air temperatures.

**UNIFORM HEATING,** controlled automatically. No impingement. No overscaling. No washing. Minimum maintenance... Bottom making practically eliminated. This is due to extremely accurate control of temperature and atmosphere.

Get the facts about F.E.I.—
the complete buy—from original
planning through to actual production.

F-4

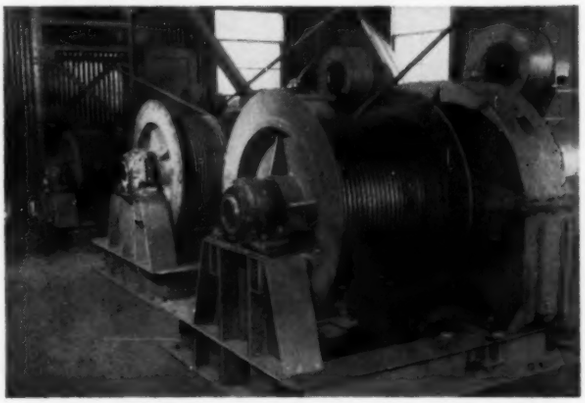
*Write for This Bulletin covering all types of F.E.I. Heat Treating Furnaces.*

**Furnace Engineers, Inc.**

F. E. I. Building • 1551 West Liberty Avenue • Pittsburgh 16, Pa.

AFFILIATES—*Great Britain;* Salem Engineering Co., Ltd., Milford near Derby, England;
*France, Belgium, Holland, Luxembourg and Italy:* Heurtey & Co., 38 Av. G. Mandel, Paris XVI, France.

This 720 ton-per-hour Barge Unloader . . . designed, fabricated and erected by Heyl & Patterson . . . was recently put into operation for the Duquesne Slag Co., Pittsburgh, Pa.



The Close Drum and the Hold Drum (right and center), which raise, lower, open and close the bucket, are operated by two 200 H.P. motors. The Trolley Drum (left) is operated by one 100 H.P. motor.

All motions of the Trolley and Bucket are easily controlled by a single operator.

# ADVANCED DESIGN
## is the RESULT of
## COOPERATIVE PLANNING

## *by Heyl & Patterson*

The improvement of Heavy Bulk Materials Handling Equipment for the world's major industries . . . Steel, Mining, Power, Transportation, Aluminum . . . calls for Engineers, Fabricators and Erectors instilled with the urge for constant improvements . . . improvements based on actual past experience and on modern thinking and planning . . . with the one thought of building better equipment.

Heyl & Patterson is fortunate in having men of this type . . . men who realize that improvements come only as the result of experimenting in the engineering department, in the research department and in the field.

Heyl & Patterson Engineers have to be specialists in Heavy Bulk Materials Handling Equipment because they have undivided responsibility for the successful operation of all H&P projects.

Complete cooperation for our design engineers is assured because we have ***Our Own*** Engineering Department . . . ***Our Own*** Research Department . . . ***Our Own*** Structural Shop . . . ***Our Own*** Machine Shop . . . ***Our Own*** Erection Department.

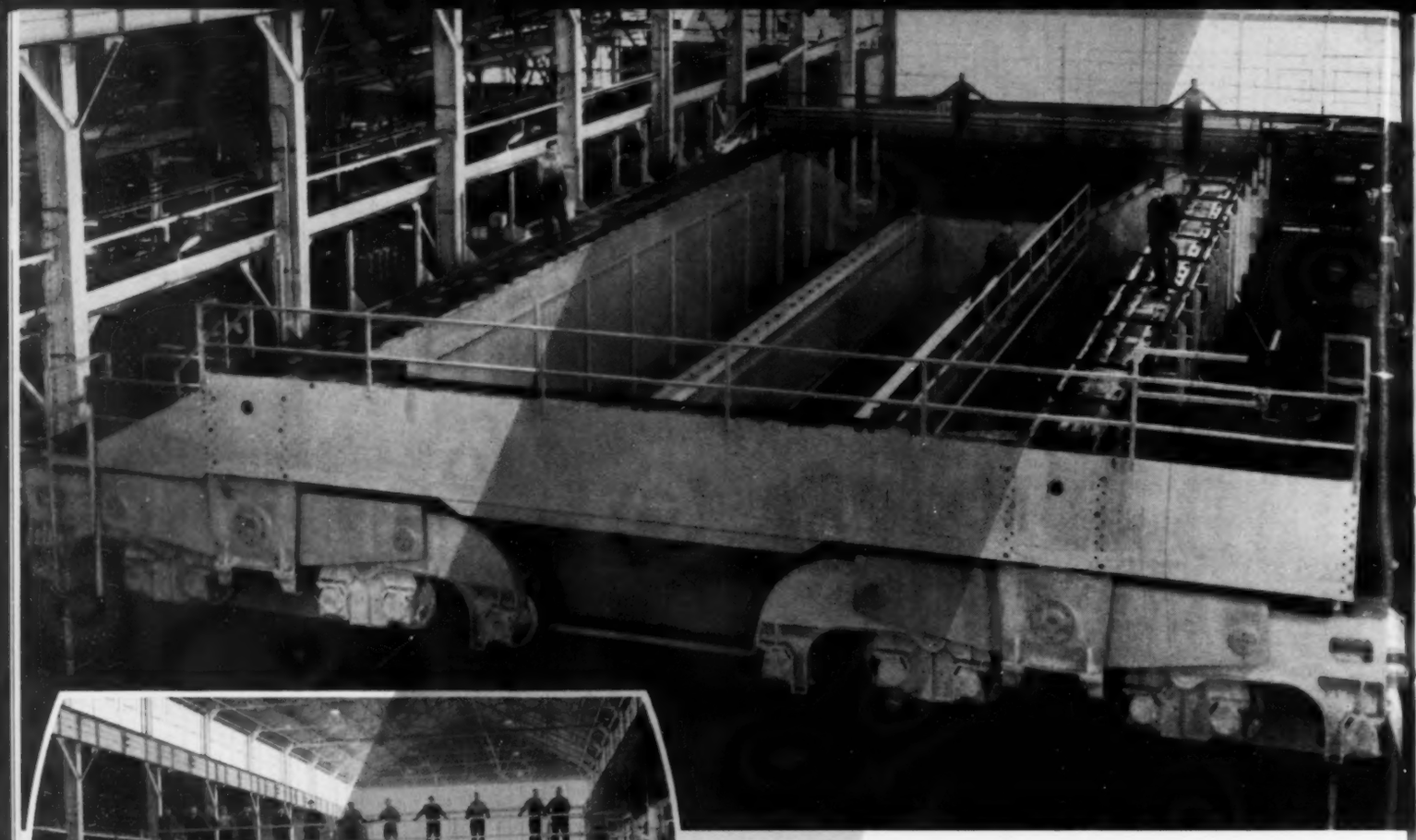
Every man on our Sales Staff is an experienced, practical engineer with a firm belief in the need of advanced design. Their first duty is to understand your problems. Then it is the duty of every member of the H&P organization to see that you get complete cooperation . . . all the Way, from the original design to the successful operation of your equipment.

Heyl & Patterson can guarantee ***Controlled Low Cost*** because every phase of any Heavy Bulk Materials Handling Equipment Job can be produced entirely within ***Our Own*** organization.

Ore Bridges
Railroad Car Dumpers
High Lift-Turnover-Rotary
Coal Preparation Plants
Coal & Coke Handling Equipment
Boat Loaders and Unloaders
Rotary Mine Car Dumpers
Coal Crushers
Coal Storage Bridges
Car Hauls and Boat Movers
Bradford Breakers
Refuse Disposal Cars
Thorsten Coal Sampling Systems
Kinney Car Unloaders
Pig Iron Casting Machines
Cyclone Thickeners
Thermal Dryers
The Drying Dutchman
Reineveld Centrifugal Dryer

**Heyl & Patterson, Inc.**
"SINCE 1887"
55 WATER STREET • PITTSBURGH 22, PA.

**Heavy Bulk Materials Handling Equipment**
***All The Way from Design to Erection***



BRIDGE SPAN 76 FEET, OVERALL WIDTH 60 FEET

## world's biggest ladle crane gets final inspection . . . . it's 350/60/25 TON ALLIANCE BUILT

● You're looking at two pictures of the world's largest ladle crane, shown, during final assembly, on the erection floor of the Alliance Machine Company.

This 350/60/25-ton, 4-girder, vibration-free giant will soon be helping one of the world's largest steel producers increase production capacity.

It's equipped with 24 track wheels on the bridge. The crane is so designed that each track wheel bears exactly 1/24th of the total load. And, like all Alliance Cranes, built for handling hot metals, raw materials, and finished products, it's safer, easier to operate and many times more efficient.

## even bigger model now being built

The never-ending demand for bigger, better lifting power has kept Alliance on a constant path of research and development. For more than 50 years, Alliance has been the world's largest producer of the world's largest cranes.

Now in production are three 450-ton, 4-girder Alliance ladle cranes. These will be the largest ladle cranes ever built.

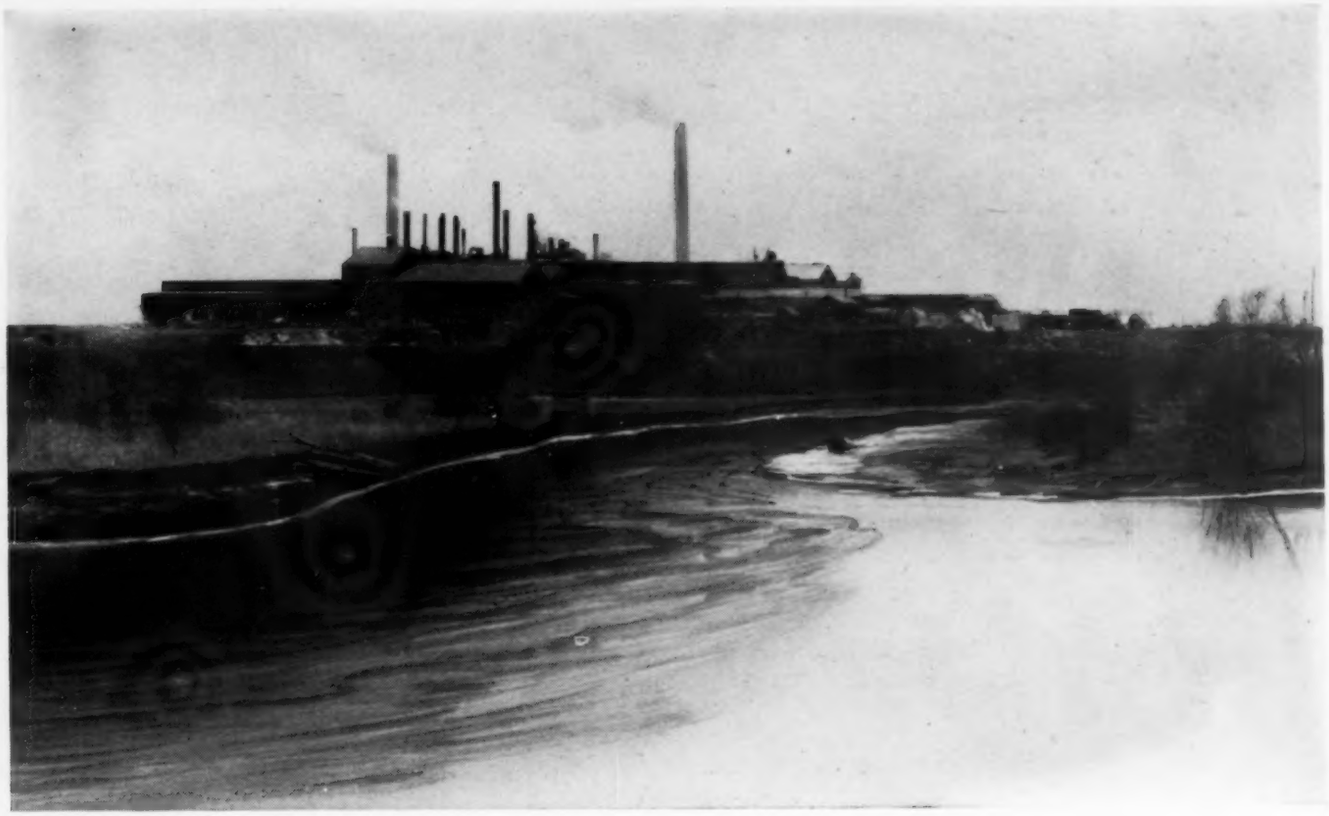
Let Alliance engineers help you with your heavy material handling problems. Write us today for an early consultation.

**THE Alliance MACHINE COMPANY**

*World's largest builders of world's largest cranes*

MAIN OFFICE
**ALLIANCE, OHIO** • PITTSBURGH OFFICE
**1622 OLIVER BUILDING, PITTSBURGH, PA.**

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION



# WORRIED ABOUT WASTE DISPOSAL?

## Bailey Meters Help you to Reduce Pollution

● The disposal of industrial wastes without stream pollution calls for careful planning and continuous vigilance.

That's where Bailey Meters and Controls come in. We measure the flow and pH of sewage, sludge, and industrial wastes flowing in open channels or pipe lines. These and other factors, such as levels, rates of chemical feed, and flow of air, may be co-ordinated into a completely automatic system for the treatment and disposal of waste materials.

When you want fast, complete and authoritative answers to the measurement and control aspects of your waste disposal problems, reach for your phone and call your local Bailey Engineer. Offices in all principal industrial centers.

P-24

**BAILEY OPEN CHANNEL METERS**

These indicating, recording and integrating meters are suitable for measuring industrial wastes, sewage, sludge, corrosive liquids, and irrigation water flowing in all types of open channel primary metering devices, such as Venturi flumes, weirs, or nozzle flumes. Electric or pneumatic telemetering permits location of receivers wherever desired. Ratio of flows and chemical feeds may be controlled automatically.

BAILEY METERS

**BAILEY METER COMPANY**

1047 IVANHOE ROAD
CLEVELAND 10, OHIO

*Process Controls*
TEMPERATURE · FLOW
PRESSURE · LEVEL
GAS ANALYSIS · RATIO

# One of these large SELF-COOLED POWER TRANSFORMERS could have been ordered by YOU...

37500 Kva,
132000 Grd. Y-
24000Y/13860 Volts

INERT GAS PRESSURE

## Method of OIL PRESERVATION

INERT GAS-OIL SEAL

20000 Kva,
110000Δ-
34500 Grd. Y Volts

OIL EXPANSION TANK

25000/31250 Kva,
72000Y-13800Δ Volts

If you are a user of transformers, you probably prefer a particular method of oil preservation for your transformers.

Here are three Power Transformers that were recently manufactured by Pennsylvania Transformer Company. Of special interest is the fact that each transformer is equipped with a different method of oil preservation.

No doubt one of these methods, if not all of them, would meet with your requirements. But no matter what oil preservation method you specify, you can be certain that when it is incorporated into a Pennsylvania Transformer, it will function efficiently with the same amount of dependability as the rest of the transformer.

Pennsylvania TRANSFORMERS

**Pennsylvania TRANSFORMER COMPANY**

CANONSBURG, PA. • *Greater Pittsburgh District*

# Faster Heating Pits

Typical of Salem-Brosius' leadership in service to the metal-working industry are the highly efficient ingot heating pits built by the Salem Engineering Division. These pit-type furnaces are well-known for rapid, uniform and accurate heating, easy operation, economy, great durability, and reduced scale loss. If you have a problem which involves the use of heating furnaces, blast furnace equipment, or charging and manipulating machines, it will pay you to call on highly experienced and diversified Salem-Brosius today.

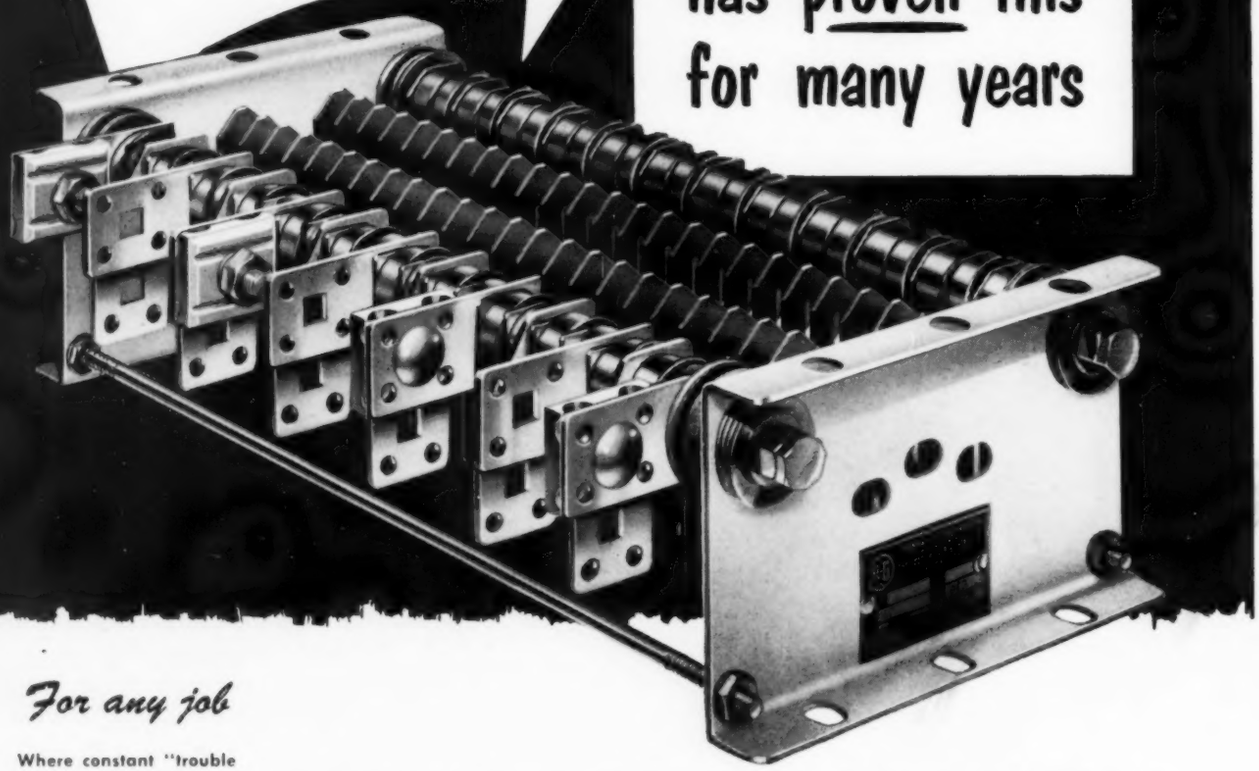
## SALEM-BROSIUS, INC.

SALEM ENGINEERING DIVISION, SALEM, OHIO

BROSIUS DIVISION, PITTSBURGH 15, PA.

# There is a *difference* in Resistors

P-G has proven this for many years



*For any job*

Where constant "trouble free" resistor service is wanted...you can safely specify P-G Steel Grid Resistors and get better performance with low cost maintenance.

Different, because steel and mica, both extremely durable materials, coupled with P-G exclusive design produce a resistor of great mechanical strength. There is nothing to break. With accurate resistance values and adequate carrying capacities, P-G Resistors outlast ordinary resistors. Tell us your specifications and let P-G solve your resistor problem.

P-G

*The Nonbreakable Steel Grid Resistor*

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

# REDUCE ROLL GRINDING COSTS

$ $ $ $ $ $ $ $ $ $ $

# USE FARREL® ROLL GRINDERS

Reports from users indicate that the latest type Farrel machines provide a two-way cost reduction in roll grinding.

**1.** Rolls can be ground *faster*, which results in lower labor cost per roll ground.

**2.** Rolls last longer because of the exceptionally smooth and vibration-free action in roll, wheel and traverse drives which means that less metal has to be removed in roughing and finishing operations. This reduces the frequency and cost of roll replacement.

Send for further information about these cost-reducing roll grinders. They are available in two types—type HD shown here, and type TT with traveling work table. Bulletins giving complete specifications of either type will be sent promptly on request.

**FARREL-BIRMINGHAM CO., INC., ANSONIA, CONN.**

*Plants:* Ansonia and Derby, Conn., Buffalo, N. Y.
*Sales Offices:* Ansonia, Buffalo, New York, Pittsburgh, Akron, Chicago, Los Angeles, Houston

FB-715

# ANNOUNCING

## THE IMPROVED

# Exide-Ironclad

## BATTERY

YEAR AFTER YEAR, one Exide-Ironclad improvement has followed another. It is a record of continuing progress . . . a steady flow of storage battery developments that have made Exide-Ironclad YOUR BEST POWER BUY AT ANY PRICE.

NOW COMES ANOTHER Exide-Ironclad advance . . . . . a polyethylene insulating tube sealer. This and other improvements combine to give you more dependable battery performance and longer-than-ever battery life.

Exide-Ironclad BATTERIES
YOUR BEST POWER BUY →
. . . AT ANY PRICE

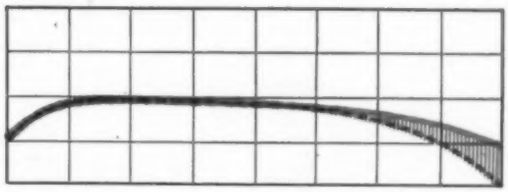
# BUILT TO GIVE YOU...

**RAPID ACCURATE HANDLING . . . UNIFORM RATE OF HANDLING... HIGH AVAILABILITY... LOW OPERATING COSTS... LOW MAINTENANCE COSTS... LOW DEPRECIATION COSTS... HIGH MANEUVERABILITY... SAFE HANDLING**

## BECAUSE OF:

**IMPROVED POSITIVE PLATE CONSTRUCTION**
the long-life grids now contain SILVIUM —an alloy of silver, lead and other components—which make them highly corrosion resistant. Top conducting bar is heavier.

**... with the New Polyethylene insulating tube sealer**
An insulating sealer for the bottom of the tubes. Acid-proof, non-corroding plastic it fits snugly into slotted tubes of positive plate, and reduces loss of active material. Even the small sediment deposit of the past is reduced 50%. Thus, more active material remains available, and the high battery capacity is sustained for longer working life. (See chart at right.)



**PERMANIZED NEGATIVE PLATES**
Improved processing, a result of Exide Quality Control assures uniform plates with higher electrical efficiency. These negatives, teamed with the improved positive plates, give you a well-balanced combination for hard service and long life.

**NEW SEALING COMPOUND**
Through the cooperative efforts of Exide Laboratories and the Franklin Institute, a new homogeneous compound was developed. It makes a permanent seal between the jar and cover, resisting shock without cracking in high or low temperatures.

**SEAMLESS SHOCK-PROOF JAR**
Made of high quality rubber. A scientifically selected combination of tensile strength and elongation provides a sturdy jar built for long life and heavy-duty service.

**CORROSION-RESISTANT TRAY GUARD**
A plastic acid-resistant steel tray coating with high insulating quality and ability to withstand hard knocks.

**NEW UNBREAKABLE PLASTIC VENT PLUGS**
Made of unbreakable polyethylene. Can be quickly and easily removed to add water.

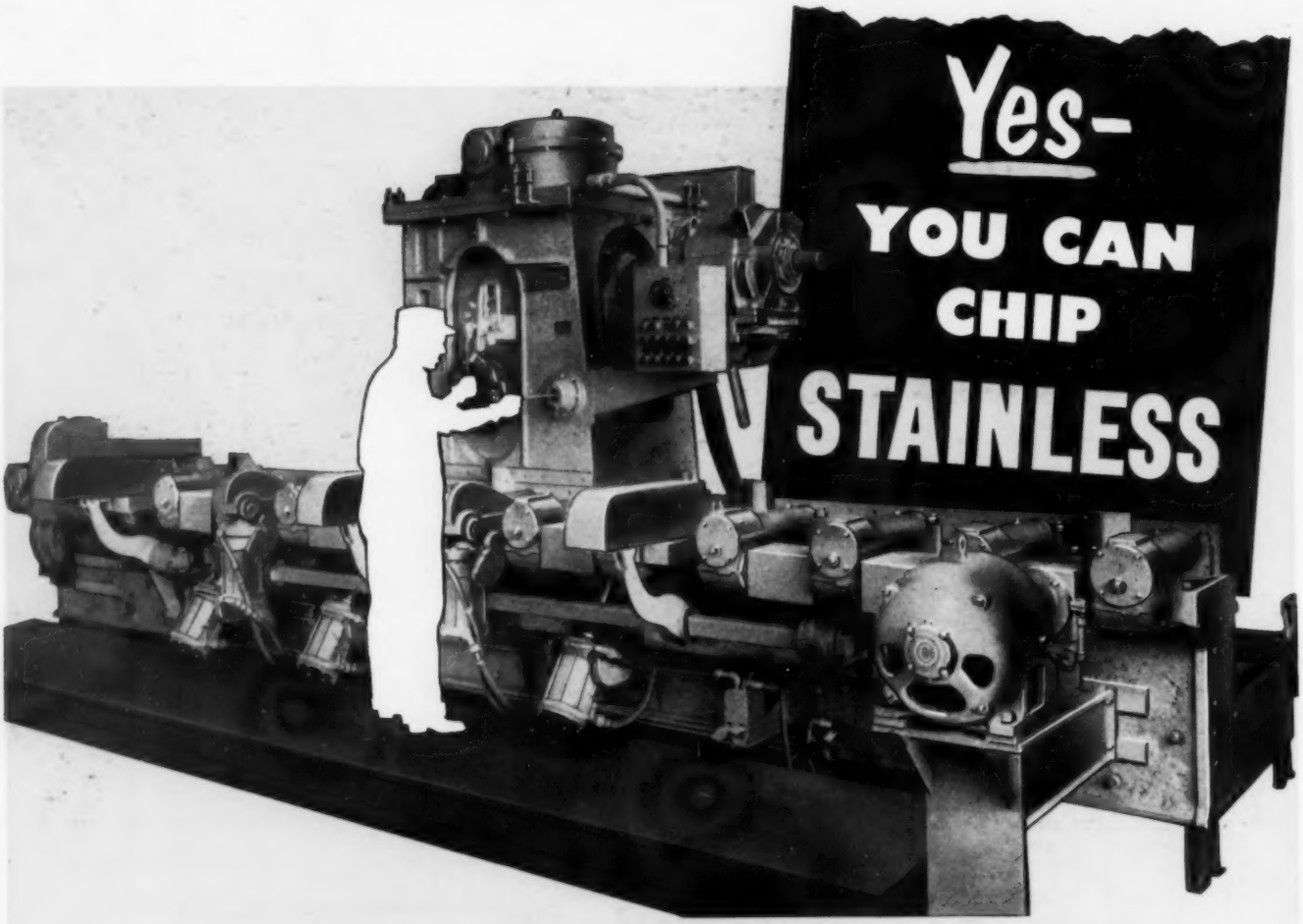
Types and sizes for storage battery applications for every heavy-duty service.

*Write today for further information.*

**THE ELECTRIC STORAGE BATTERY COMPANY**
**Philadelphia 2**

***Exide Batteries of Canada, Limited, Toronto***

"EXIDE-IRONCLAD" and "PERMANIZED" *Reg. Trade-marks U.S. Pat. Off.* "SILVIUM" *T.M. Reg. applied for*




# . . . and the Bonnot Billeteer easily handles other "Tough Babies" too!

Bonnot Billeteering is producing surprising results with stainless steel. While we are not inferring that the "highest-brinell rated" stainless is being chipped, *exceptional results are being consistently obtained in brinell classifications under 400.*

And when it comes to toughness, let's consider 52100 high chrome, high tensile steel that's always a problem to condition:

With a Bonnot Billeteer the operator completely skinned (full surface removal) *in just 8 hours,* 8 sides of 7" square blooms, 10' long plus 5 sides of 14" square, 15' long . . . *2900 square inches per hour with Bonnot Billeteering.*

Yes, steels of the toughest varieties—with or without annealing treatment—are being successfully chipped by the Bonnot Billeteer every day, everywhere in the industry.

If you still are struggling with laborious, dangerous billet conditioning methods it will pay you to find out about Bonnot Billeteering. A real investigation of production being obtained may surprise you greatly. Never a better time to find out—and never an obligation.

*Engineered For Improved Production*

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO

Also Manufacturers of — SAWING • PULVERIZING AND MIXING EQUIPMENT • BILLET INSPECTION TABLES
CRUSHING • DUST PUG MILLS • SINTER PLANT PUG MILLS

# NOW—

## Keystone ALUMINUM Conductor System for all Applications

### A NEW, COMPLETE SYSTEM OFFERING HIGH CURRENT CAPACITY AND LOW IMPEDANCE

Keystone introduces a new development—an aluminum conductor (third rail) system. In addition to conserving critical copper and steel, it offers industrial users many important operating and structural advantages. Here is a complete sliding contact system which is pre-engineered, efficient and compact in design, yet constructed for years of service. It has high current-carrying capacity . . . up to 1,000 amperes . . . with a small cross-sectional area.

Non-magnetic, the new Keystone Aluminum third rail system provides good voltage regulation for alternating current because of its low impedance. It offers new economies because it is easier to install, requires less manpower and eliminates the need for high-cost supporting structures.

It is designed for such applications as main crane runways, bridge conductors, hydro-electric dams and numerous other jobs.

If you have a collector problem or plan a new installation replacement of an old system, consult our engineering specialists.

**OPERATIONAL FEATURES**

- Requires less space
- Operates under conditions unfavorable to other metals
- Easy maintenance
- Pre-engineered components for easy assembly.

**Write today for new, illustrated 4-page folder on Keystone Aluminum Conductor System.**

## ELECTRIC SERVICE MANUFACTURING CO.

PHILADELPHIA 32, PENNA.

● Steel means security! And today, production is greater than ever. To help get every possible ton of open-hearth production the industry has turned to "Zebra" roof construction.

In more than 90% of existing "Zebra" roofs, Grefco's patented RITEX-40 STEELKLAD brick are used in alternate rings with Silica brick in zones of greatest wear. This exclusive unburned chrome-magnesite brick is permanently jacketed in a steel shell which becomes an integral part of the brick.

Results show more heats per campaign, reduced repairs, lower costs. Under severe service conditions, RITEX-40 STEELKLAD has no equal, because the rings protrude beyond, and protect the

# Stripes of Superiority

# GENERAL REFRACTORIES

**GENERAL REFRACTORIES COMPANY**
PHILADELPHIA

Silica brick from destructive gases. The Silica brick make possible a strong, mechanically stable roof.

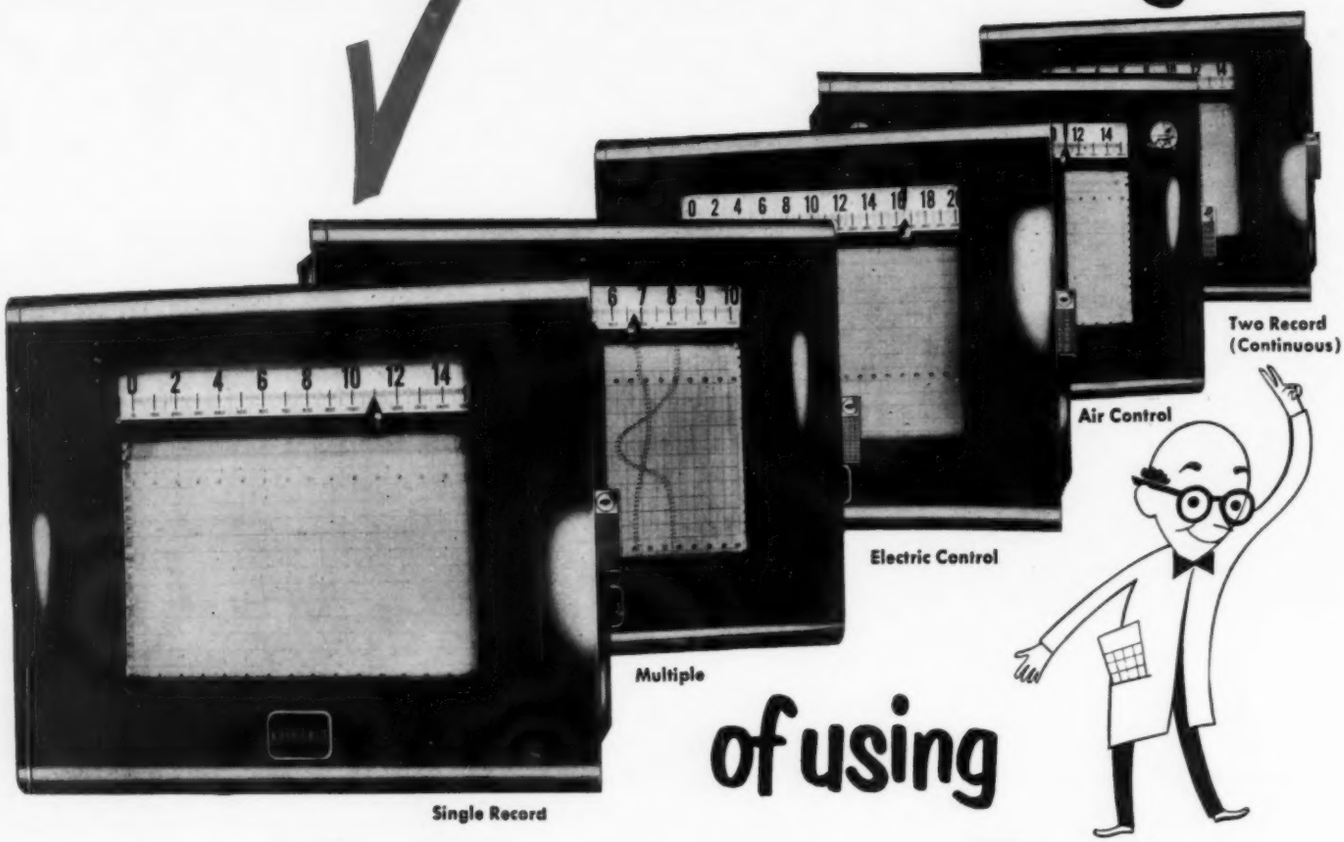
In modern open-hearth furnaces you'll also find front and back walls, monkey walls, and furnace ends, of STEELKLAD. Elsewhere in the open-hearth, as well as in other parts of the plant, you'll find Fireclay brick, Silica, High Alumina, Basic brick, and Specialties... all from General Refractories' international string of 43 mines, 23 plants, 18 sales offices and 200 distributing agencies.

Important, too, is Grefco's research laboratory, where better refractories are constantly being developed. In short, General Refractories Company provides you with a Complete Refractories Service!

**A Complete Refractories Service**

●

# CHECK the Advantages




# of using the Dynamaster Family

***Electronic temperature recorders and controllers***

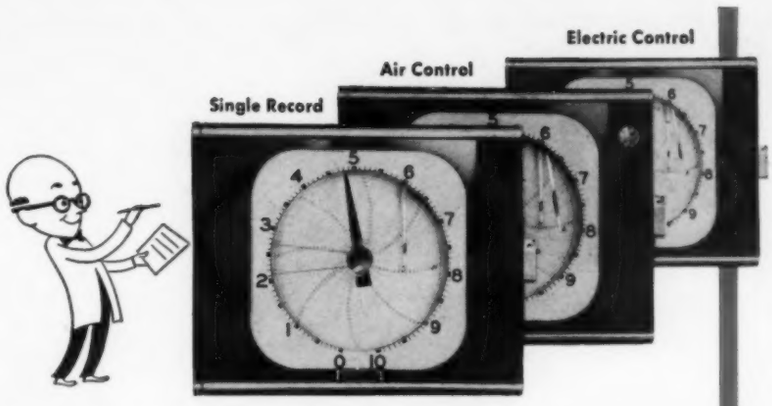
Strip chart or circular chart recorders . . . recorders with slow or fast pen speeds and chart speeds . . . single or multiple recorders . . . automatic controllers . . . all in the same case with identical components except the chart-drive mechanisms.

This variety-with-standardization assures you of easier installation, better looking control panels, simpler maintenance. The service man who knows one Dynamaster, knows them all.

## BRISTOL

*The dependable Guidepost of Industry*

**AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS**




***"Everyone who sees these Dynamasters is impressed with clean simplicity of internal design."***

# You'll be impressed too

**WITH FEATURES LIKE THESE:**

Models to measure any variable convertible into d-c voltage, d-c current, resistance, capacitance

Continuous-balancing electronic circuit assures instant response

All types of electric and air-operated controllers offered

Little or no maintenance

All models use the same easy-to-replace components

Electronic unit uses vacuum tubes available at any radio supply house

Full-scale pen travel of 7, 3 or ⅗ seconds

Chart speeds from ¾ in. per hour to 7200 in. per hour.

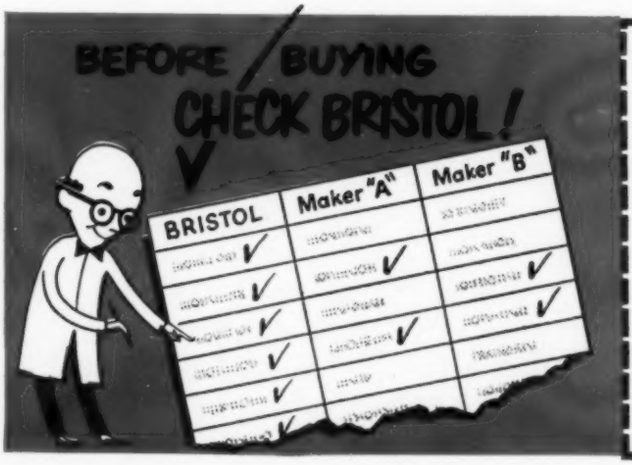
Multiple recorders up to 16 points

Practically immune to vibration, shock, or external stray currents

**YOU'LL WANT TO GET** *full details by using the coupon to order Catalog No. P1245.*

# COMPANIES LIKE THESE
## *are using Dynamasters*

North American Cyanamid Limited
Jones & Laughlin Steel Corporation
Raybestos-Manhattan, Inc. Manhattan Rubber Division
Consolidated Edison Co. of New York, Inc.
Friez Instrument Division, Bendix Aviation Corp.
Scovill Manufacturing Company
Pratt & Whitney Division, Niles-Bement-Pond Co.
International Harvester Company
Westinghouse Electric Corporation
The Johns Hopkins University
United Aircraft Corporation
The Sponge Rubber Products Company
Commercial Solvents Corporation
Armstrong Cork Company
United States Steel Company
Collins Radio Company
Baldwin-Lima-Hamilton Corp.
Ruge- de Forrest Company
National Bureau of Standards
Bausch & Lomb Optical Company
Koppers Company, Inc.
Bell Aircraft Corporation
The B. F. Goodrich Company
Boeing Airplane Company
Industrial Nucleonics Corp.
E. I. du Pont de Nemours & Co., Inc.
Automatic Temperature Control Co., Inc.
Swindell-Dressler Corporation
Woods Hole Oceanographic Institution
Jarrell-Ash Company
National Research Corporation




**THE BRISTOL COMPANY**
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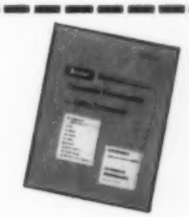

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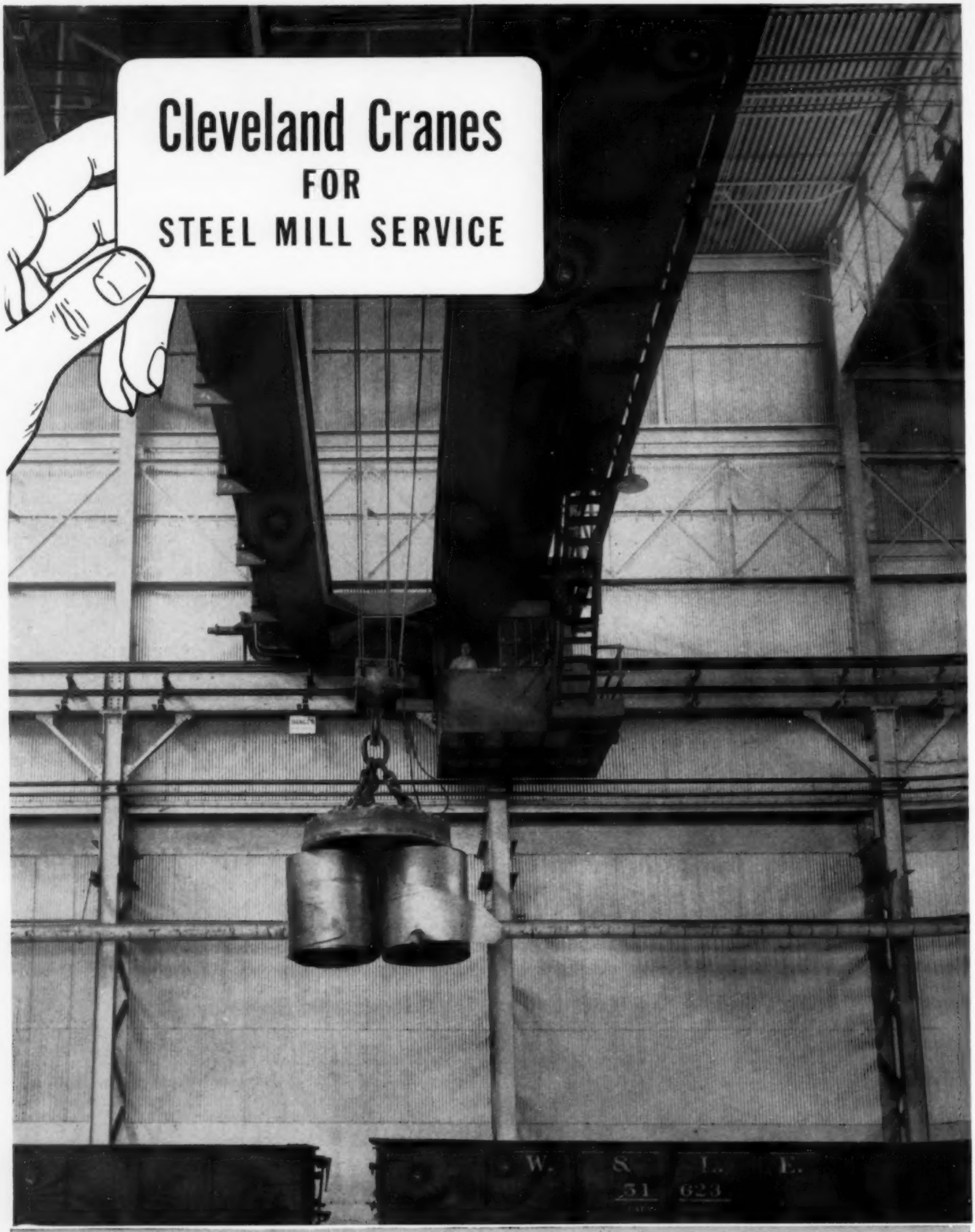


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# Crops and Shorts

LAST month on this page, we ended an item on the government seizure of the steel industry with the sentence: "As we go to press, we're wondering just how much of the Constitution is left — and who's next." Now, one month later, we're still wondering.

Seizure was followed by immediate and bitter reaction. Legal batteries, both government and industry, went into action, and bureaucrats mouthed meaningless bunches of vacillating verbiage. Eventually, positive action appeared in the ruling by Federal District Judge David A. Pine that the steel seizure was illegal. Steelworkers, who had returned to work with government seizure, immediately walked out again. Next, the U. S. Circuit Court of Appeals, by a split vote of five to four, put the mills temporarily back in possession of the government, pending an appeal to the Supreme Court. Incidentally, one of the five judges voting for government retention of the industry is named George Washington.

The U. S. Supreme Court then agreed to review the case as to the constitutionality of government seizure of the industry, and at the same time, the court ruled that the government cannot change wages and working conditions until other issues have been settled.

And so, as we go to press again, we're wondering. We can't help but feel that the court will find for the administration, but then we didn't believe that the seizure would be declared illegal in the lower court, either. We hope we're wrong again.

▲

DURING the turmoil attending the steel negotiations, price stabilizer Ellis Arnall said they couldn't permit a steel price increase on the basis of steel company estimates of the results of recommended wage increases, however accurate they might be. But the Wage Stabilization Board was sufficiently prescient to say that wages should be raised at mid-year and again at year-end.

▲

IT isn't really true that Harry S. Truman's middle initial stands for seizer.

▲

THERE'S never a dull moment at the meetings of the Association of Iron and Steel Engineers. The end of the 1949 spring conference at Baltimore was marked by a fire in the hotel; the 1949 convention in Pittsburgh opened the same day as a general steel strike; the 1951 convention in Chicago was attended by a fire in the hotel; and as the crowd returned from the inspection trip to Armco's Middletown plant, which marked the end of the recent spring conference in Cincinnati, they were greeted by headlines of Judge Pine's decision that the government seizure of the steel industry was illegal.

In spite of the uncertainty of the steel situation, the 1952 spring conference had a total attendance of 750, who enjoyed the meeting and in some cases the hospitality across the river in Kentucky. Fortunate indeed were those who were able to enjoy the gastronomic delights set forth by Andre at the Gourmet, atop the Terrace Plaza Hotel. As one reverent convert remarked: "The check was sort of high, but why question the price of heaven?"

▲

NET income of the iron and steel industry for 1951 totaled about $668,000,000, nearly 13 per cent under 1950 in spite of a 22 per cent increase in sales volume, represents a return of 5.74 per cent on sales and 9.5 per cent on capitalization. Total sales were approximately $11,600,000,000; payrolls, $3,400,000,000; materials and services purchased, $5,400,000,000; taxes, $1,250,000,000. Incidentally, the net income amounted to about $6.80 per ton of ingots.

Many steel companies have indicated cut-backs in their expansion programs and planning, pending clarification of the situation on steel prices and wage costs.

▲

THE average hourly rate of wage earners in the steel industry during 1951 was $1.945.

▲

A NUMBER of companies are presenting awards to their employees for the best papers prepared on the company activities for technical societies and magazines. Recently announced by Dravo Corp. was a $300 cash award (second prize) to G. H. Atwood, chief engineer of the company's crane and bridge department. Mr. Atwood's paper, dealing with an unloading and handling system for imported iron ore, was published in the Iron and Steel Engineer for June, 1951.

▲

UPON moving back into the White House, President Truman received a gold master key to the rebuilt house from Gilbert W. Chapman, president of Yale & Towne Manufacturing Company. Significantly, a plaque on the key's carrying case bears this statement:

"In a free society, the key to a man's house symbolizes his and his family's rights to those privacies and freedoms which are the heart and sinews of the American Way of Life.

"This key and the locks it operates are products of the skills and ingenuity of American men and women living and working safe in their liberties.

"With God's help, may it ever be so!"

▲

THE largest single rapid-amortization package to be approved by the Defense Production Administration to date, is the $298,000,000 project of Erie Mining Company for a beneficiation plant for taconite. Erie is jointly owned by Bethlehem Steel Company and Youngstown Sheet and Tube Company.

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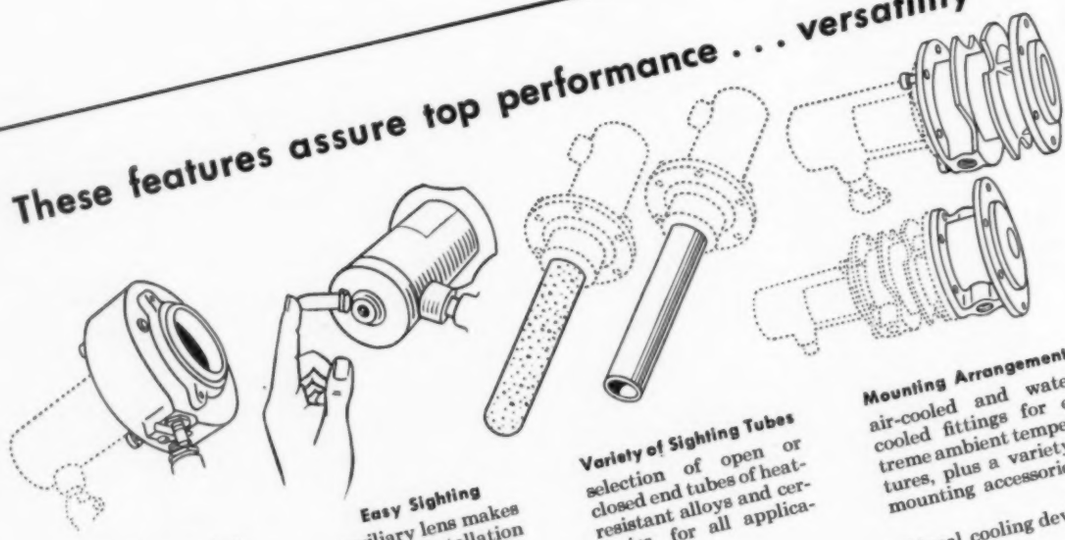

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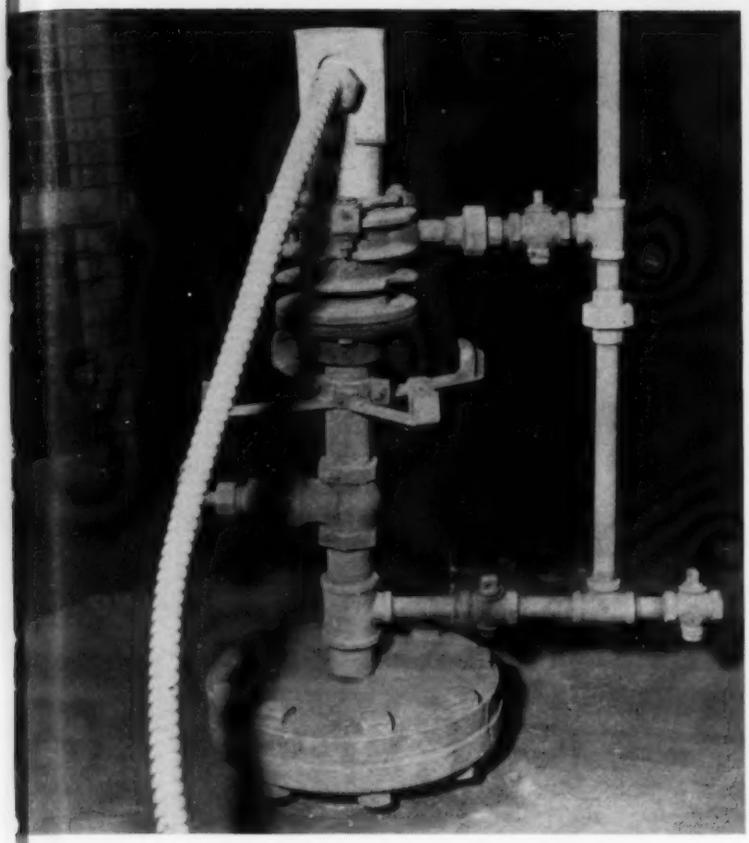
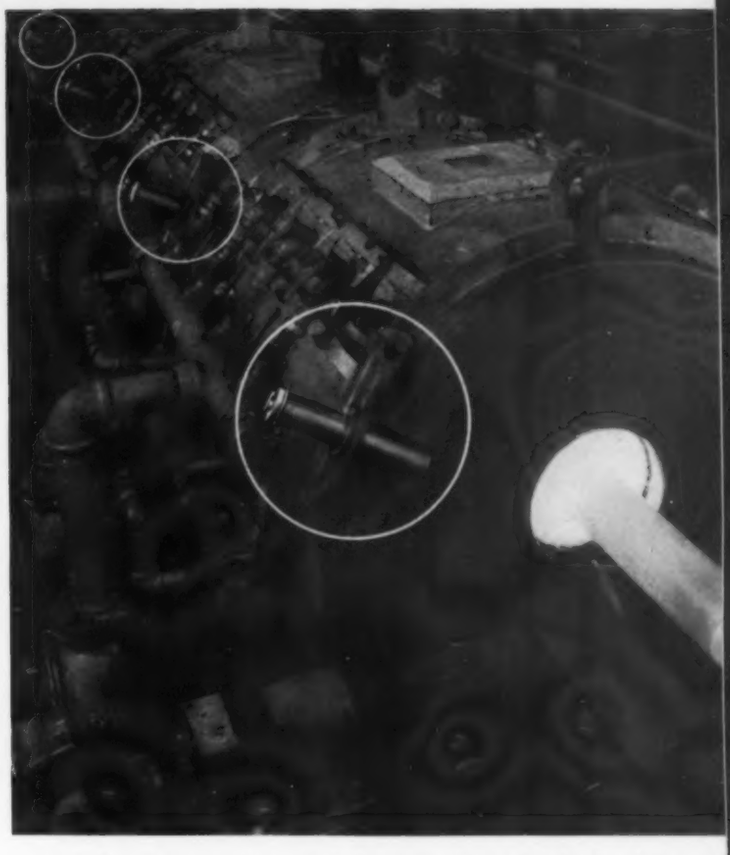


***Radiamatic** lasts longer than thermocouples for blast furnace stove dome measurement.*



***Radiamatic** pyrometers control temperature of tube leaving this continuous reheating furnace.*

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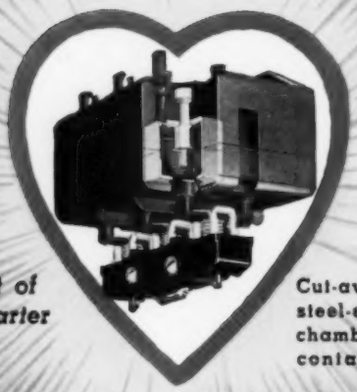
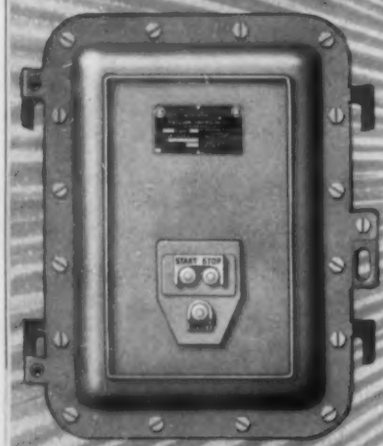


*The heart of the CY Starter*

Cut-away view of steel-enclosed arc chamber with main contact assembly



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# Iron AND Steel ENGINEER

MAY, 1952 VOLUME XXIX NUMBER V

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*Published Monthly by*
ASSOCIATION OF IRON AND STEEL ENGINEERS
1010 EMPIRE BUILDING
PITTSBURGH 22, PENNSYLVANIA

*Statements and opinions given in articles and papers appearing in "Iron and Steel Engineer" are the expressions of contributors, for which the Association of Iron and Steel Engineers assumes no responsibility.*

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*Indexed by Engineering Index and by Industrial Arts Index.*

Single Copy Foreign Prepaid $2.00 Single Copy $1.50
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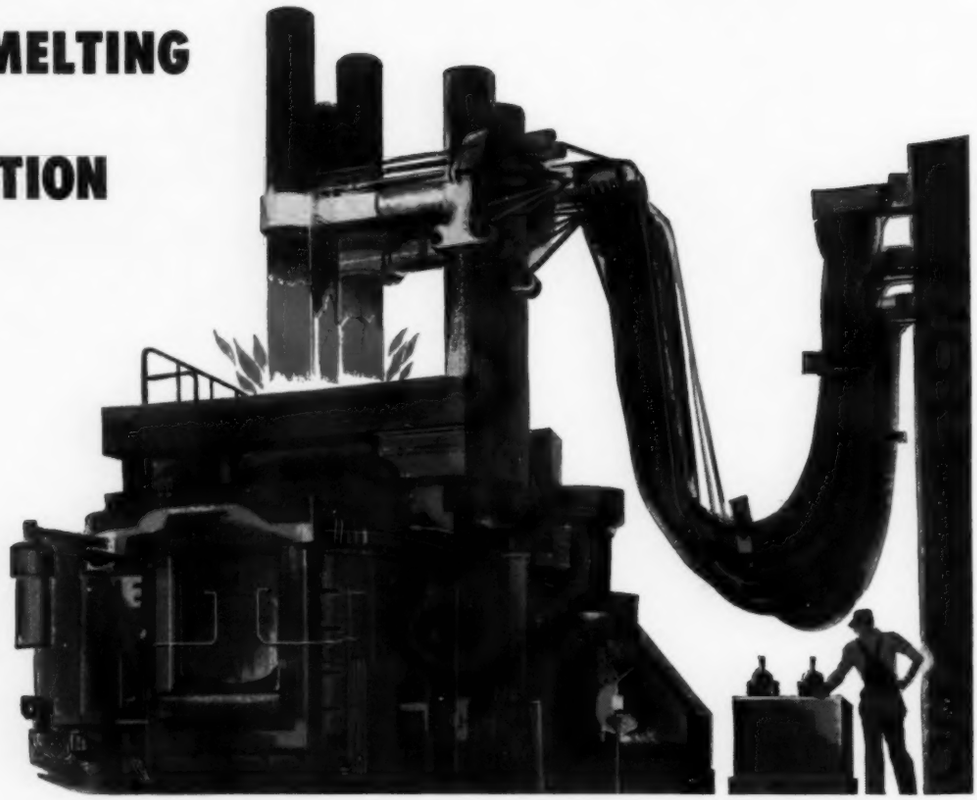

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MOORE RAPID

WHEN YOU MELT... Lectromelt

# Accurate Steel Mill Weighing

By K. A. BLOM
Corporation Weighing Supervisor
Republic Steel Corp.
Cleveland, Ohio

K. A. BLOM

***. . . . accurate, reliable steel mill weighing cannot be had without special efforts . . . . flexure-plate scales have, in particular, given good results . . . .***

▲ ACCURATE steel mill weighing involves many different problems and it is not possible to embrace all of them in this paper. The writer has therefore chosen to confine the subject to some of the most common weighing problems confronting the steel industry. These problems fall in two distinct categories, and the paper is presented in two parts, the first of which deals with accounting problems, while the second part is dedicated to problems concerning scale repairs and preventive scale maintenance.

To start with, it may be helpful to clarify what is meant by "accurate weighing." The word "accurate" is in itself something of a Utopia. When applied to weighing and particularly weighing on large capacity, heavy duty scales, the word becomes almost absurd. No scale of such heavy design is capable of rendering "accurate" weights in the true sense of the word, and neither is such ultimate accuracy called for.

In a modified version, therefore, we may consider that a weight is accurate, if it conforms to certain tolerances. As the National Bureau of Standards specifies a scale tolerance of plus or minus one part in one thousand, a scale may be considered accurate, if it will *consistently* repeat the *known weight* of a test piece within such a tolerance. Hence between two scales of that accuracy, there may be a justifiable spread of two parts in one thousand and this means that a weight (other than sealed test weights) may be considered accurate for commercial purposes if it conforms to a tolerance of plus or minus 2/10 of 1 per cent. In keeping with this theory, Republic is making every effort to hold all shipping scales within the recommended scale tolerance of 1/10 of 1 per cent.

## WEIGHING FROM AN ACCOUNTING VIEWPOINT

*Importance of Accuracy* — In the eyes of an accountant, weighing is a very important function which holds the key to any number of taletelling calculations such as cost per ton, yields, tons per hour, etc., and last but not least, it is through weights we determine the sales value of the products we ship. To illustrate that we are talking about real money, and not just trivial amounts, bear in mind that consistently "slow" weights of as little as ½ of 1 per cent may mean a lost revenue in the neighborhood of $4,000,000 based on a shipping performance of 7,000,000 tons of steel per year. That equals 57 cents per ton, and since we have to live with the cost and expense of weighing, regardless of its quality, such an amount of money demands a constant vigilance over the efficiency of our weighing equipment as well as the personnel responsible for the weighing. It is good advice to look after your weighing equipment, and the person who operates it, with the same watchful

**Figure 1 — Shown here are the fulcrum stands located on base plates which are elevated to the scale datum line and levelled both ways. The base plates are provided with levelling screws. A master precision level is used for this work.**

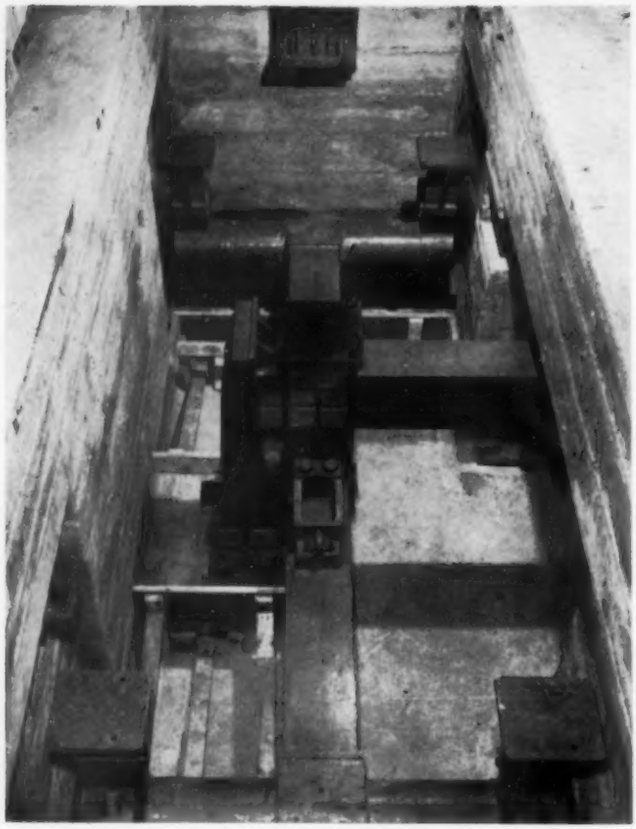


**Figure 2 — Illustration shows the complete lever system lined up, but not grouted in. At this point the indicating instrument has been connected and a sensitivity test may be taken before grouting. High sensitivity proves absence of undue strains. Installation of levers must take place from center and out, exactly following true and square centerlines.**

**Figure 3 — This is a detail of a girder chair as used at the "fixed" end of the scale. Notice the flexure plates. The web of these particular plates has a thickness of 0.200 in. and is 8 in. long, providing a total bearing surface of 1.6 sq in. in each corner.**

eyes you would keep on your cashbox and the person in charge thereof.

It is true that the "law of average" would prohibit such a thing as consistently slow weights from a large number of scales involving a multitude of weighings, but unfortunately this "law" is not effective when processing a shortage claim. When a customer figures he is "short," that's it. It will help but little to tell him that the law of averages will make it up in shipments to come. Who ends up paying the bill? You do! And in most of the cases, who suffers a loss in case of overages? Again, you are right — you do! It is a losing game anyway you look at it.

There are, of course, many other less obvious, but nevertheless fully as important issues depending on weights. If, for instance, your butcher gives you 15 ounces of meat and calls it a pound, you are not going to like him no matter how good his steaks may taste. It is the same with steel or any other commodity — the customer wants *all* that he is paying for. On the other hand, labor will demand payment for every pound of steel produced.

Such and many other considerations caused the management of Republic Steel Corp. to appoint a weighing committee, consisting of representatives from all departments concerned, to study weighing conditions throughout the operations and make recommendations for changes and improvements, designed to bring about conditions under which the highest practicable degree of weighing accuracy could be realized.

*Elimination of Track Scale Check-weighing* — The committee's first target was track scale check-weighing of outbound product shipments. In 1948, just as Republic's weighing program started, the railroads were permitted by the Interstate Commerce Commission to increase their fees for track scale weighing from 57 cents per car to $1.12 per car.

Up to that time, it was established practice in all of our plants to light- and heavy-weigh every car containing outbound steel shipments and to check the net weight against the shipping manifest to insure at least, that the total weight was correct. In spite of the fact that carload weighing involves many uncertain factors which tend to impair its accuracy, especially during the winter months, this method of checking shipments is nevertheless rather desirable from a standpoint of insured accuracy. However, considering the tremendous volume of cars to be weighed in this manner, the weighing committee unanimously agreed that the price for this insurance was too high. They argued, that if we had to spend that kind of money to safeguard ourselves against incorrect shipping weights, it could be spent to better advantage by improving the weighing facilities in the plants where the steel is weighed for shipping purposes in the first place.

The result was a total revision of the existing weighing manual. Track scale check-weighing of outbound products was entirely eliminated and so was carload weighing of a number of other commodities, inbound or outbound. Besides affording substantial tangible savings, the decision to curtail track scale weighing proved highly beneficial in many other ways. Since approximately 40 per cent of the cars which formerly had to be weighed, were now permitted to go directly to the outbound track or unloading station, yard switching

problems were considerably simplified and yard congestion greatly reduced. The intangible savings thus effected should not be underestimated.

*Supervision* — So far, all that had been done was to rob ourselves of a time accepted method to police the performance of our shipping scales and the diligence of the weighers, loaders and other personnel involved. It was, therefore, rather obvious to all concerned that some revision of mill weighing practices would be necessary along with the introduction of some system, whereby weights and weighing could be controlled adequately and efficiently.

The first step was to provide a closer contact between the accounting department and the weighing operations in the plant. To this end a weighing supervisor was appointed for each steel district in the corporation. These are high-grade men, well acquainted with steel mill operations. They are responsible to the district accountant, but enjoy the necessary freedom to investigate all questions concerning scales, weight discrepancies and weighing conditions in their district to whatever extent they may deem it necessary.

They make their opinions and recommendations known through a monthly report, copies of which go to all members of the weighing committee. In order to promote interchange of ideas between the districts, copies of these reports are also furnished to each one of the other weighing supervisors.

The principal duties of the weighing supervisors are:

1. Schedule and witness scale tests.
2. Inspect scales for balance and cleanliness.
3. Observe weighing and instruct weighers.
4. Test-weigh random bundles of products to check accuracy of weights already determined by weighers.
5. Arrange for random trackscale check-weighing of carloads.
6. Investigate any weight claim for cause and propose measures to prevent recurrence.
7. Investigate scale damage for cause and suggest means of protection against scale abuse.
8. Perform such other duties as may be required in the interest of accurate weighing.

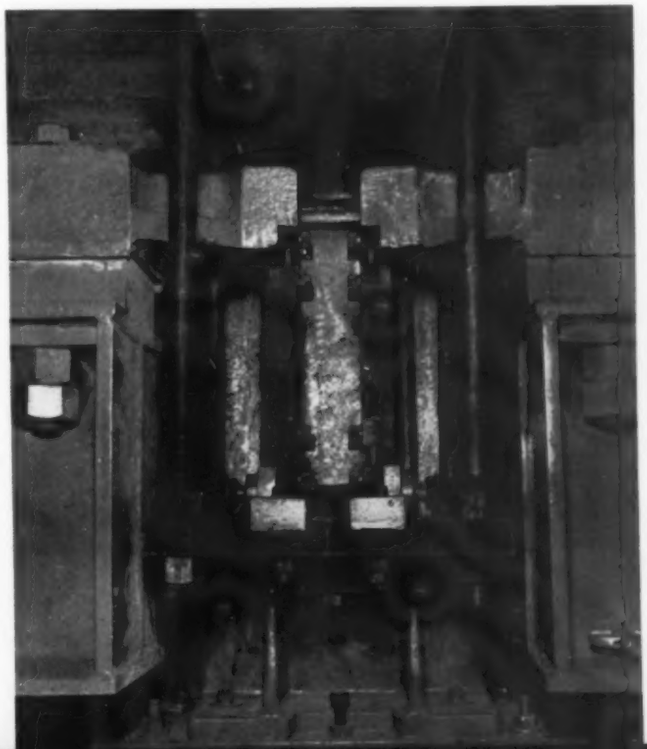
They also attend the weekly operating meetings, keeping the district management advised on all matters pertaining to scale conditions, weighing, claims, etc.

Make no mistake about it, this is a full time occupation. The mere thought that the district employs a man occupied solely with weighing, has had a tremendous psychological effect on the weighers and everybody else in the mill. We have to make every man from the mill-hand to the superintendent *weight conscious*. Preaching the subject is not enough — we must also practice what we preach. And Republic has been doing just that.

*Modernization of Equipment* — Since the start of the weighing program we have furnished every shipping scale and a number of production scales, with automatic indicating and weight-recording dials in almost complete abolishment of beam-weighing with its poises and cumbersome counter weights. Automatic recording dials compute the weights faster and much more accurately than the weigher can by manual operation of the weigh-beam poise. Moreover, they print a clear figure on a ticket, a tape or a sheet of paper, thus providing a far

**Figure 4 — This detail shows a girder chair in the "movable" end. The rocker plate directly underneath the chair permits expansion or contraction of the girders, without straining the flexure plate beneath. The rigid checks hold the flexure-plate in plumb position, but allows minute movements up and down.**

**Figure 5 — This is the suspension arrangement of the end levers where they meet in center of pit. Note the double set of flexure plates which will allow expansion or contraction of the levers without exerting undue strain on the flexure plates. This whole center assembly is rigidly checked against side motions which may occur during shock-loading.**



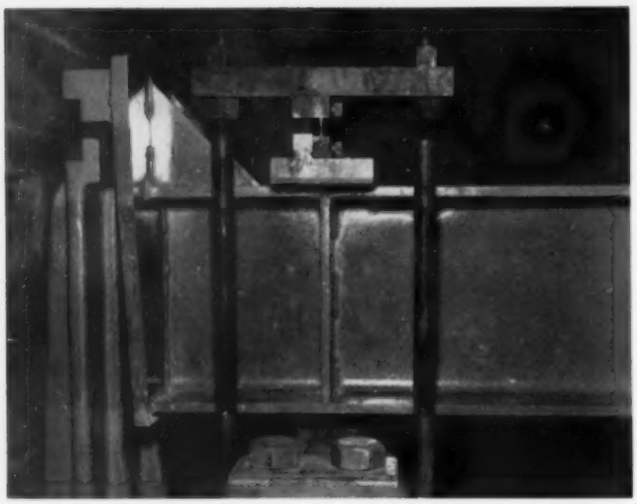


**Figure 6 — This shows how the weight, now reduced in proportion to the ratio of the end levers, is transferred to the transverse lever leading to the indicating instrument via a steelyard rod connection.**

better and more reliable record than a hand-written one with all its possibilities of faulty poise manipulations, erroneous summation of counter weight values and transposition of figures.

In the immediate vicinity of all shipping scales, we have placed at the weigher's disposal, a suitable test piece of a predetermined weight with which to check the scale at least at the start of every turn and also at any time the weigher may be in doubt about the performance of his equipment. If he finds his scale out of tolerance more than 1/10 of 1 per cent, he is instructed to abandon it and immediately notify the scale service department.

At weighing stations where the work-load is particularly heavy, or where it is required to check theoretical weights against actual weights, calculators or adding machines have been provided. Visual improvements talk louder than words and tend to make the weighers

**Figure 7 — This picture shows the tip end of the transverse lever and the nose iron. The pivot used at this point constitutes the only loose connection throughout the rigid checkrod; it will sing if hit with a hammer.**

feel that their job *is* important. The natural human reaction is to apply themselves to a higher degree.

This is not mere philosophy. Beyond doubt our weighers are more interested and doing a far better job today that at the start of the program a few years ago. Now, the cases are few and far between when the weighing supervisors, by periodical random check-weighing of individual bundles, may find one that is not accurate within the modified definition of the word. On occasions when an off-weight bundle of steel is discovered, several more are checked. If the weights of these are also found to be out of tolerance, the scale involved is thoroughly tested.

We feel that this procedure is giving excellent results and that it provides the necessary control of all weight *determining* factors.

*Control of Tallying and Loading Errors* — What about loading errors, incorrect tallies, etc.? How do we attempt to control these factors without a track-scale check-weight?

From time to time it happens that the loaders may include in a car an extra item, or leave one out. Maybe a bundle of ½-in. rounds is loaded erroneously with a shipment calling for, say 1/16-in. rounds. Such and other errors may easily take place during the rush of getting shipments out on time and with the extra precaution of carload check-weighing removed, mistakes of this kind are not likely to be uncovered in time to be corrected. They will in due course, result in a claim.

This is one of the reasons, why all shipping scale dials are furnished with recorders which are used to print the weight on a ticket. The ticket we use has the form of a tag. It is a duplicate ticket designed to provide a prominent space for the printed weight in addition to all other pertinent data. This duplicate ticket is attached to the bundle by the weigher. At time of shipment, the loader will remove the original part as the bundles are transferred to the car and attach them to the loading tally, thus enabling the billers to check all data pertaining to each item shipped.

In case of cold, or at least cool material, the other part of the ticket, which is in effect a manila tag carrying identically the same information as the detached original, remains on the steel. Unfortunately, this is not feasible in case of extremely hot material, since the tag would burn or become charred beyond recognition. To cope with this situation we are now experimenting with metal tags, soft enough to receive indentations in an automatic weight printer.

Although this system is not entirely foolproof, it does eliminate many possibilities for errors which in its absence would be detected only too late to be corrected.

*Weight Discrepancy Claims* — Periodical check-weighing of random cars indicates that a high degree of weighing accuracy has been achieved in this manner. So do statistics on weight claim experience, compiled quarterly and yearly for the purpose of "feeling the pulse" of our weighing performance. These statistics show, that claims due to weight discrepancies have decreased gradually in most of our plants during the past few years, with the corporation average showing an all-over decrease of about 14 per cent in 1949 and 18 per cent in 1950 compared to a composite base year, fluctuations in tonnages shipped duly considered.

Someone might inject that this favorable claim ex-

perience could possibly mean that we are now giving away more steel than ever before, rather than interpreting it as an indication of improved weighing performance. If this were true, however, we should certainly have experienced an increase in the small percentage of overage claims. Since this is not so, we feel confident that the improved claim experience does indicate that an improvement in weighing performance has been achieved, although it is recognized that other factors may also have had their influence.

Through studies of individual weight claims as they occur, we aim and hope to improve our claim experience further. Most claims of this nature are avoidable and they are more than a nuisance in that they are a completely uncalled for source of irritation to a customer.

While Republic's efforts to obtain accurate, reliable weights entail many other details, the foregoing will serve to cover the highlights of what is being done insofar as elimination of *human* errors are concerned.

## SCALE REPAIRS AND PREVENTIVE MAINTENANCE

In the following paragraphs, the writer will briefly endeavor to relate where Republic is going from a mechanical viewpoint, in order to keep its scale equipment in good working order. This subject may be closer to the heart of this forum, since the foregoing has mainly stressed weighing problems from an accounting standpoint.

*Repair Forces, Tools and Shops* — Each steel district maintains a scale repair department, headed by a scale repair foreman with one to six scale repairmen, depending on the size of the district and the number of scales involved. In all, a total scale repair crew of 34 men services more than 1000 scales, from large capacity track-scales to small portable units. The scale repair department is under the jurisdiction of the mechanical superintendent of the district.

Although scale repair departments have been maintained for years, in some cases the extent of the shop was merely a place to eat lunch — a screwdriver and a wrench the only tools. Repairwork of any magnitude was either contracted for, or partly referred to other crafts where a job order for scale repair was more often than not pushed aside in favor of other job orders considered more urgent. Our weighing committee feels strongly that a scale service department should be equipped to tackle any scale installation or repair job — big or small — depending as little as possible on outside help. That should be why they exist.

If the weighing requirements are to be met, it is essential not only that the weighers be alert and precise, but also that the weighing equipment be provided with means of quick repairs and good maintenance. In most of our districts, therefore, the scale repair shops have been enlarged and equipped with the tools and machines deemed necessary in order that the department may function, as far as possible, independent of other crafts.

A list of tools and machines recommended for scale repair after a careful study and discussion with all our scale repair foremen, presents itself as follows:

a. Small lathe.
b. Surface grinder.
c. Milling machine.
d. Floor drill press.
e. Light bench drill press.
f. Bench or floor grinder with assortment of wheels.
g. Small shaper.
h. Oxy-acetylene welding torch.
i. Forge.
j. Sealing beam.
k. Complete set of sealed test weights.
l. Gage micrometers.
m. Monorail hand hoist.
n. Set of jacks.

The writer does not intend to imply that all of Republic's scale repair shops are so equipped and it should, of course, be fully understood that this equipment is recommended only if the scale repair crew have men adequately qualified to operate it. However, with this equipment and experienced men, almost any scale repair job can be taken care of very efficiently.

**Figure 8 — In this picture, the scale has been grouted and the bridge is in place. The check plate in the far end has been located completely level and has been dowel bolted to the bridge and the wall bracket. That is the "fixed" end of the scale. The "movable" end is barred from side movements by a rigid check rod. The deck of this scale rests loosely on shock absorbing pads in each corner.**

In some of our larger districts where scales are located in plants scattered over a wide area, we have found it worthwhile and time-saving to operate a well-equipped scale service truck. Only in this manner has it been possible to answer trouble calls with a minimum delay and without increasing scale repair man hours.

*Scale Equipment* — A steel mill is not a healthy place for any scale, however ruggedly it may appear to be constructed. Shock or impact loadings are among the worst offenders and they are, in our opinion, responsible for the major share of all scale trouble. We all know that the effect of a shock depends roughly on the depth

**Figure 9 — This picture illustrates how the deck fits on the girder. The shock absorbing pads are held by boxes, in the girder and the beam supporting the platform. This construction resists horizontal movements of the otherwise loose platform and is a special feature of this particular installation.**

of fall, the weight of the object and its speed. We may measure shock in lb-in., but we cannot readily say, for instance, that 10,000 lb-in. equal a 5-ton normal load. Since the effective actual pound value of impact is virtually incalculable, the rated capacity of a steel mill scale should be several times the weight of the heaviest object it is intended to weigh. The initial extra cost of such a scale will be trivial compared to the maintenance headaches you invite, should you elect to save that extra expense and install a lighter scale. Our experience tells us that we should at least triple the weight of the heaviest, single load to be weighed, when determining the rated capacity of a new scale. The capacity of the dial should not exceed 60 per cent of the scale capacity, since most scale manufacturers do not recommend using a knife-edge scale in the upper-half of the rated capacity, at least not frequently.

As you all know, a heavy duty scale consists of two separate lever systems: the load receiving levers, usually located in a pit beneath the platform, and the beam lever or weighbeam located on a stand above the floor. In case of a dial, the beam lever is located inside a cabinet and is connected with the dial indicator through a rack and pinion in the dial head, where a set of pendulums do the work of a beam poise. The load receiving levers reduce the weight placed on the platform by any given ratio; the beam lever is designed to pick up the reduced weight, counterbalance it and indicate the amount of weight momentarily supported by the platform.

*The Dial* — Let us first consider some of the hazards facing a dial in a steel mill. Whatever its capacity, a dial is a very delicate, precision-built instrument. Therefore it must be adequately protected. A single blow by a lift of steel on a cranehook or on a tractor, may reduce a dial cabinet to a useless heap of scrap in less time than it takes to tell about it. They cost money too, from about $1000 to $4000 and $5000 for certain types, and it has been our experience that the cost of good protection is money well spent. In all cases where for some reason a dial cannot be located inside a weigh house, a sturdy barricade of 4 × 4 in. billets concreted in the floor and with welded cross bars, is erected around the instrument. It is high time we realize that even a heavy-duty, large capacity steel mill scale is a highly sensitive instrument and that there are certain limits beyond which we cannot go without impairing its accuracy.

Impact loading may prove as injurious to a dial as to the scale itself. Dislocated racks, stretched sector and pendulum tapes are some of the effects. Worse yet, are chipped or flattened beam lever knives, causing inertia and possibly a change in lever ratio.

Wherever it can be accomplished, standardization of equipment simplifies maintenance problems. In its recommendations, the weighing committee emphasized the advantages of standard dials, but left it up to the individual districts to decide which make or design would serve them best. However, it went on to suggest that the type thus chosen by any of the districts, should thereafter be used in that district as standard recording dial, except as agreed in unusual cases.

With a standard type dial, the scale service people may be trained to repair that one type expertly, instead of doing a mediocre job on five or six different makes. To help accomplish this, we made arrangements with the manufacturers of the various types of dials chosen, to have the scale repair foreman of each district attend an instruction course at the factories. This put our people in position to obtain first-hand knowledge of

**Figure 10 — Scale repair shop at Republic's Canton, Ohio steel plant. On left is one of the scale service trucks.**

proper maintenance methods applicable to the particular make for which they would become responsible.

Standardization offers a decided advantage in simplifying the spare parts problem — only a small stock is required to insure quick repairs to any standard dial. In case of complete breakdowns, the repair shops need have on hand only one or two spare dial heads, which may be placed in service within hours instead of after a long wait for factory replacements. This permits the old dial to be repaired and calibrated in the shop without delaying the mill.

Under an efficient foreman, the spare dials may also serve a valuable purpose in that they can be used as training equipment in the shop.

*The Knife Edge Scale* — Next let us consider the scale itself. Heavy duty lever scales of various designs are obtainable in capacities ranging up to as high as 400 tons for railroad scales. Predominantly these scales are of the type commonly referred to as "knife-edge" scales, indicating that their load receiving levers pivot on knife edges opposed by bearings. Impacts and shocks, such as is the daily experience on steel mill scales, cause rapid wear and deterioration of the knife edges. These

must be reasonably sharp and arranged in a very definite relation to each other in order that the scale may function properly. The distance between them must be properly gaged; on this depends the multiplication or lever ratio. They must also have a certain "range" which determines the lever's stability of equilibrium. Wear changes these values and the effect is inaccurate weights and frequent balance changes. The gradually increasing friction due to worn knife edges renders the scale insensitive to load changes.

Several of the levers are provided with means of adjustment to correct a change in lever multiplication. The power arm pivot (or knife) may be moved to shorten or lengthen the power arm enough, so that the multiplication of the scale will again agree with that built into the beam lever. This is what a scaleman refers to as "moving the nose-iron," an operation which is so simple and so convenient that many scalemen of inadequate experience "move the nose-iron," rather than taking the trouble to find out where the error actually originated. The writer seriously believes we would have better scales if "nose-irons" did not exist. To correct one error by introducing another, invariably leads to more errors and more trouble than ever before.

However, knife-edge scales have served mankind faithfully for over a hundred years and will no doubt find wide usage in decades to come, in spite of the fact that science is rapidly progressing along completely different lines to overcome or reduce the effects of wear and friction in weight computing instruments.

*The Flexure-plate Scale* — This type of scale may be known to some. The principle has been used in railroad track-scales since about 1915 and it is known that some track-scales of this design are in use in several steel plants. Due to their higher initial cost, they are not common even as trackscales, and as far as we have been able to ascertain only six scales of flexure-plate design were in use as mill scales until recently.

We have at our Youngstown plant one track-scale which dates back to 1917 and another one installed in 1930. They are cared for by an experienced scale repair foreman. According to him, these scales have been in uninterrupted service all these years, and no adjustments or maintenance other than periodical painting and conditioning of the steel work have been required. Yet these scales are as sensitive and accurate today as the day they were installed.

Records of maintenance manhours show that for each hour spent on the flexure-plate scales, knife-edge scales of comparable capacity required two and a half hours. When the number of cars weighed is taken into consideration, the ratio is 1 to 4½ in favor of the flexure-plate scales.

**Figure 11 — Scale shop shows emphasis which Republic places on scale repair facilities.**

It is possible to obtain flexure-plate scales in smaller capacities, namely 30, 60, and 100 tons per section. These scales are of a standard design with parts and fittings interchangeable within each capacity group, but they have a wide flexibility as to both length and width of platform. Platform sizes of the scales we have installed vary from 8 × 6 ft to 60 × 4 ft. All of these scales have been proven sensitive to load changes equal to one-quarter of the dial increment value.

In Republic, replacements with this type of scale have been made in locations where knife-edge scales formerly suffered frequent breakdowns due to shock loading or where they for other reasons failed to give satisfactory service. During the time these new scales have been in operation, no trouble calls have been reported, no adjustments have had to be made, and numerous tests have proved them accurate.

In its construction the flexure-plate scale does not differ radically from that of the knife-edge scale. It does differ from that scale mainly on two counts:

1. All pivots, knives and bearings have been replaced with flexure-plates, the design of which is illustrated in several of the illustrations. These plates are machined to very accurate specifications in regard to all dimensions as well as parallelism, squareness and centric location of the webb. When in position, the gage between the plates is figured from exact center to center of webb. This gage always remains constant, thus there are no changes possible in lever multiplication. The strength of a single load plate in a 60-ton scale has been tested to 168 tons or 42,000 lb per lineal in. Since there are two load plates in each scale section, a safety factor of 5½ to 1 is indicated. Compare this strength with the 6000 lb per lineal inch for knife edges, as specified by AREA.
2. The load bridge is rigidly checked to pit walls, so as to definitely prohibit *any horizontal* movement of the platform. It is completely rigid and thus the flexure-plates underneath are kept in plumb position. The scale levers are also checked in a like manner, disallowing any other movements than the "up and down" motion activated by force of gravity.

This movement of the scale levers is permitted by minute bending of the flexure-plates, rather than by pivoting a knife-edge on an opposing bearing surface. In this fashion the designer has entirely eliminated wear in a lever scale. Since the friction or resistance offered by the flexure-plates and the rigid checks, are constant at all points of lever movement, *this adverse force allows itself to be predetermined and its effects eliminated during the initial calibration of the scale.*

No fatigue failures have been reported in the flexure-plates in any of our scales during their 34 years of use.

The rigidly checked weighbridge, combined with the greater bearing surface which it is possible to build into the flexure-plates, offers a far greater insurance against the ill effects of shock loading which in a relatively short time would kill the sensitivity and impair the accuracy of a knife-edge scale of equal capacity rating. In making

this statement it is not the writer's intention to say that the flexure-plate scale is a "cure-all," but we do believe that this design is eminently suited for heavy-duty use.

The success or failure of the flexure-plate scale lies entirely in the manner in which it is installed. Since there are no loose connections throughout the scale to allow for misalignments, such as in case of knife-edge scales, the former must be installed *completely square, definitely plumb* and *level to the "Nth" degree*; there can be *no* laxity as to these three requirements. It is, incidently, our contention that a knife-edge scale would give better and longer service if these same requirements were always followed to the letter on installations of that type. Insofar as flexure-plate scales are concerned, it is imperative. This cannot be emphasized enough, since a plate installed out of plumb will have lost much of its strength and all of its usefulness.

## CONCLUSION

It has not been the author's purpose to write a treatise on scales. Those mentioned above are of the types we use in our steel plants, namely mechanical lever scales. Since most of our scale trouble stems from that source, and since it is believed that our problems may also be prevalent, it seemed natural to speak of them to some extent.

There are, of course, several other types of scales featuring a wide variation of advantages. Some of the more recent developments are hydraulic and electronic scales, both of which seem to have the promise of a great future. Let us hope the day is not far distant when heavy-duty weighing will cease to be a problem child.

In conclusion of the paper, the writer will again stress that accurate steel mill weighing is something that cannot be had without special efforts on the part of a number of people, and accurate reliable weights will result only if the subject receives the proper attention from all parties involved. Needless to say that goes for customers as well as shippers. Barring loss of material in transit, pilfering, hijacking, etc., the realization of accurate shipping weights is within reach.

# DISCUSSION


**PRESENTED BY**

**F. C. SCHOEN, Chief Engineer, Alan Wood Steel Co., Conshohocken, Pa.**

**K. A. BLOM, Corporation Weighing Supervisor, Republic Steel Corp., Cleveland, Ohio**


**F. C. Schoen:** As Mr. Blom states, to the accounting department accuracy is vital, however, the stress seems to be on shipping weights, and we believe that internal weights in a department, upon which quite often tonnage bonus is paid will affect profits substantially. We also wish to point to the open hearth charging scales where accurate weights are very important.

Alan Wood has recently started a program, covering modernizing not only the scales, but the weighing program which differs somewhat from the paper just presented. These differences are not radical, but perhaps for smaller companies, or small independent divisions of a single company, may be of interest.

We have not appointed an independent scale supervisor but have given the responsibility of tests, schedules, etc., to the supervisor of mill billing, who has his office and staff directly in the mills and is a part of Treasury — Accounting Department. We have also set up a training program for weighmasters, this training program being presently handled by personnel from a scale manufacturing company.

The paper states that the scale supervisor's job is "full time," however there is obviously some point where the economics would not appear to justify a full time job and we would like to ask Mr. Blom, what he considers the minimum number of scales which would warrant full time supervision.

Under the subject of modernizing equipment, we also have found the dial head for scales advantageous, however, we are specifying the type of printing dial which will not operate until scale is at balance.

*Scale Repairs and Maintenance* — As previously mentioned we have started our scale program recently and during the necessary training period for our own scale mechanics, have, on the basis of competitive bids arranged for an independent scale repair company to conduct our regular maintenance inspections, submitting necessary reports for repairs. We furnish necessary labor to handle test weights, pit cleaning, etc. These outside repair forces are also to train Alan Wood personnel in proper repair procedures.

*Scale Equipment* — We are in accord with Mr. Blom's statement of the desirability of having extra capacity weigh bridge in a steel plant, as ruggedness in general will go along with capacity, however, we are concerned with the sensitivity ratio, when using a heavy weigh bridge, weighing light loads. A scale may be accurate if sufficient time is given to bring in to balance, but balancing difficulties increase if we wish to retain the sensitivity of a scale rated to the load, in comparison to one of considerably larger capacity. For these reasons we wonder if maintenance costs trying to keep scale sensitive is not greater than the maintenance costs on normal capacity weigh bridge.

I am curious about two points on flexure scales:

1. Is the comparison between loads a fair comparison on actual loads, that is 42,000 lb per in. on plate flexure as against 6000 lb per in. maximum loading on pivot scales?
2. What effect does temperature have on accuracy of plate flexure scales?

In conclusion, we want to state our complete agreement with Mr. Blom's statement, that extreme accuracy is required in setting any scale for best results.

**K. A. Blom:** It is clearly evidenced from the discussion by Mr. Schoen that the Alan Wood Steel Co. also is making a determined effort to overcome the weighing problems peculiar to heavy industries, and the steel industry in particular.

I regret that my paper has apparently left Mr. Schoen with the impression that Republic Steel Corp. puts little emphasis on internal weighing or production weighing, as distinguished from shipment weighing. Unfortunately, in a short paper of this kind, the author is obliged to condense the issues confronting him. It will

be noticed, however, that payment of wages based on tonnage produced is mentioned as being among the important considerations giving spark to Republic's intensified weighing program. In considering first things first, it was nevertheless the consensus among the members of our weighing committee, that shipping weights present the biggest headache. Production weights, or at least those originating subsequent to open hearth operations, may be satisfactorily adjusted from month to month if need be, whereas incorrect shipping weights—once the product is gone — involve added problems, many of a more delicate nature. This approach in no way subtracts from the importance placed on the accuracy of production weighing.

In Republic we are of the opinion that the weighing supervisors constitute the pillars of the entire weighing program. Being trained as accountants familiar with steel mill operations, I would be inclined to believe they are better equipped to train and instruct weighers than outsiders. I must, however, accede to Mr. Schoen's contention that there is some point along the line where economics would appear not to justify full-time employment of a man in this capacity. In my opinion, it is not so much the number of scales under his supervision, as the size of the plant — the tonnage produced — which will govern the extent of his activities, but frankly I know of no indisputable basis upon which to judge where the limitation lies. In lieu thereof it would be my suggestion that smaller companies employ qualified accounting personnel whose *primary* duties it would be to tackle the various weighing problems.

Undoubtedly, the type of dial printer which will not operate until the scale is in balance adds to the value of the records obtained. Although this feature does not conclusively eliminate the possibility of incorrect records: "Where there is a will, there is a way." It requires greater ingenuity, particularly if an accessible tare beam is not provided. I may add that if this type of dial had been readily available at competitive costs when Republic entered its standardization program, I believe its adoption would have been seriously considered. However, only in one case has later experience indicated the necessity for such equipment.

It is not quite clear to me what Mr. Schoen had in mind with regard to difficulties in retaining the sensitivity of large capacity scales. Obviously there must be a minimum limit to the sensitivity one may demand in a scale. The Bureau of Standards specifies this limit to be equal to the value of one graduation on the indicating instrument of a new scale. In scalemen's talk, this sensitivity is referred to as the "SR" — an abbreviation for "sensibility reciprocal." We know that a "closed" pivot range affords high sensitivity, whereas an "open" pivot range gives us a more stable lever and consequently one with reduced sensitivity. Since wear of the knife edges must necessarily result in a widening of the pivot range, it is easier to understand why a worn scale, and particularly one with a worn weighbeam, is found to have lost much of its sensitivity. Of course, the added surface friction resulting from wear also plays an important part in reducing scale sensitivity, and it is in this regard we believe the flexure-plate scale has one of its greatest advantages. Since wear of pivoting parts has been completely eliminated, this scale will forever retain the sensitivity originally built into it. We have in operation scales of this type, with a rated capacity of 30 tons per section, weighing steel in one-pound increments. A load change of four ounces on these scales will produce a noticeable change in the position of the dial indicator. The scales I am referring to in this case are subject to tractor travel and severe impact loading, hence the large capacity.

In reply to Mr. Schoen's questions relative to fairness of comparing the indicated flexure-plate strength of 42,000 lb per in. to a knife edge safe load limit of 6000 lb per in., I will say, on the strength of what I have just previously explained, that I believe this comparison to be entirely fair. Not that a knife or a pivot would necessarily break under a load of 42,000 lb, but it is apparent that such a load would seriously damage the knife edges.

As to the effect of temperature changes on a flexure-plate scale, it may suffice to say the design of this scale embodies provisions for expansion and contraction of the steel, which is not true in case of a knife edge scale. In mill scales of this type, we have not found normal atmospheric temperature changes to have had any noticeable effect on the accuracy of the scales. Insofar as track scales are concerned, test records over several decades indicate only minor fluctuations of from zero to 40 lb (two graduations) in 80,000 lb. However, most of our track scales — knife edge or flexure plate — are provided with heat, primarily in order to preserve the installation and keep them free of ice and snow in the winter.


# AID DEFENSE

## MORE SCRAP TODAY . . . .
## MORE STEEL TOMORROW.

**GET IN THE SCRAP TO KEEP STEEL COMING.**

***NON-FERROUS SCRAP IS NEEDED TOO!***

# Phosphate Coatings as Lubricants IN THE Severe Cold Forming of Metals

*. . . . remarkable progress has been made in the forming of metals . . . . phosphate coatings now make operations practical which were uneconomical before . . . .*

## Part 1 - General Description

By S. SPRING

Research and Development Division

Pennsylvania Salt Manufacturing Co.

Philadelphia, Pa.

▲ THE phosphatizing of metals for severe forming operations involves the formation of a substantial deposit of a crystalline metal phosphate which is strongly attached to the surface; this is accomplished by contact of the metal being phosphated, such as steel, with a dilute phosphoric acid solution of another metal phosphate. For example, steel would be prepared for forming by immersion in a hot solution of zinc phosphate in phosphoric acid for from 2 to 7 minutes, rinsing, and then immersion in an oil or emulsion lubricant.

The phosphatizing results in a crystalline deposit. The crystalline nature of the zinc phosphate coating may be seen by examination of Figure 1, which represents the magnification of a plastic replica or faxfilm of such a surface. The zinc phosphate crystals are feathery in nature and are intertwined to form a uniform structure, but it may be noted in the photograph that the coating does not appear to be continuous. Measurements indicate that there are a number of pores in the phosphate coating, about ½ of 1 per cent extending through to the surface of the metal. In addition, there are many other pores that do not go all the way through to the steel. The pores extending through to the metal permit phosphated surfaces to rust if exposed to damp conditions, but this takes place to a much lesser extent than with untreated steel, and can be minimized by having certain chemicals in the rinse water.

Actually, the porous nature of the phosphate coating is advantageous, because this permits a quantity of organic lubricant to be absorbed in this porous matrix. This is released as the metal goes through the die thereby providing lubricant where it is most needed. Other interactions between the phosphate coating and lubricant are also of great importance and these will be discussed later.

It is of interest to consider how the phosphate coating is formed from the chemical solution. The first step involves a pickling action of the acid on the steel, which

**Figure 1 — Crystalline nature of zinc phosphate coating before drawing is shown in this magnified view.**

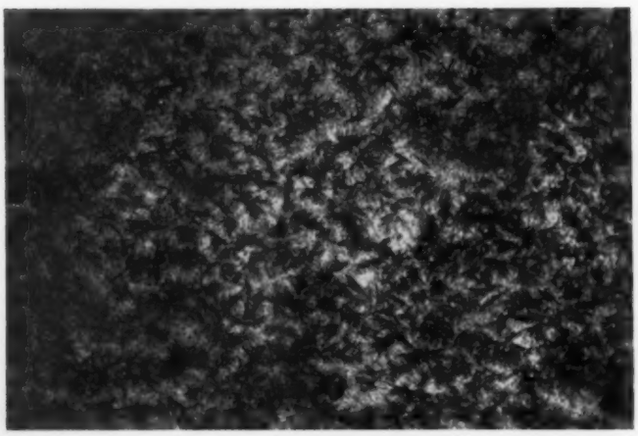


**Figure 2 — Drawing converts phosphate coating to an amorphous or glassy condition as shown here.**

has the effect of reducing the acidity in the layer of solution right next to the steel surface. This upsets the equilibrium between the zinc phosphate and the acid to such an extent that zinc phosphate is ready to be thrown out of solution. If this reduction in acidity takes place rapidly, the zinc phosphate precipitates as a white powder. On the other hand, if this equilibrium is shifted gradually, as is the case in commercial phosphatizing, the zinc phosphate will deposit on the steel instead of in the solution particularly where there are some portions of the surface that are receptive to it. Such portions may be grains of ferric carbide, particles of pickling smut, electrically active centers due to local galvanic couples, or non-metallic deposits such as might be formed by interaction between a small amount of rust and the phosphoric acid in the solution. This in general follows the principle of like materials going to like rather than to dissimilar materials. Once some of the zinc phosphate molecules become attached to these receptive centers, the process is accelerated and the zinc phosphate precipitates more readily in crystalline form on the zinc phosphate surfaces previously established.

If there are many receptive centers on the metal upon which the zinc phosphate can precipitate, there will be a tendency to form a great many small crystals yielding a fine grained deposit. If there are few receptive centers, the crystals initially formed will tend to grow in size, and a smaller number of large sized crystals or a coarse grained deposit will be formed. If the amount of phosphoric acid in the bath is relatively small so that a large amount of zinc phosphate is available to precipitate within a short period of time, the tendency will be to seek the receptive centers more rapidly and thus a large number of small crystals will develop. If the process is somewhat more gradual, because a high initial acidity is reduced slowly, the tendency would be to build up crystals which are already in existence, yielding a coarse grained deposit.

In the application of phosphate coatings to the severe cold forming of metals, the crystal size is of little importance, within reasonable limits, in contrast to the use of such coatings for improving the adherence of paint to metal, where a very fine grained deposit is highly desirable. More important than the size of the crystals is the adherence of the deposit to the steel surface; this is governed to a great extent by the intertwining action of the zinc phosphate crystals on the one hand, and by the adherence of the basis layer upon which the zinc phosphate has deposited on the other. Obviously, if the zinc phosphate crystals deposit on particles which are not adherent to the metal surface, the coating may be greater in thickness, but it would not remain on the steel surface under the high shearing stresses at the die. For this reason, an excessive amount of pickling smut or burnt drawing lubricant should be avoided since these could cause much zinc phosphate to precipitate on loosely attached receptive centers with the result that the adherence of the total coating to the steel might be relatively small. On the other hand, a pickled surface gives better adherence than an unpickled surface because it provides a larger surface area to which the basic layer of zinc phosphate can attach itself and thereby increases the adherence of the total coating.

Because the formation of the zinc phosphate coating is dependent upon a decrease in the acidity in the layer of solution right next to the steel surface, it is important to avoid an excessive residue of the pickling solutions such as may be due to poor rinsing. This strong acid would slow down the action and cause the coating to form less readily. Similarly, an excessive amount of alkaline residue from an alkaline cleaner should be avoided. This would cause the precipitation of the zinc phosphate to occur rapidly because of neutralization of the phosphoric acid, but the coating formed under these circumstances, while it might be heavy, would not be adherent to the steel surface. Therefore, an adequate rinse should precede phosphatizing whether the metal is treated in an acid pickling solution or in an alkaline cleaner.

To answer the question of why a phosphate coating is so effective in lubrication during severe forming of steel, we must consider the functions of a lubricant under such conditions. The prime function of a lubricant is to keep the surface of the steel part being worked from coming to within molecular distances of the tool used to work it, since such a contact would result in immediate welding of the parts and subsequent galling of the work. This has been recognized for a long time and a number of types of lubricants have been used in an effort to prevent it.

Oily or emulsion lubricants containing fatty acids that are adsorbed on the steel surface have been used to provide a layer of extraneous matter between the surfaces. These, however, are easily displaced by shearing stresses and can be used only for the milder type of draws. Lubricants containing extreme pressure lubricant additives are designed to react with the metal surface to form a thin film of oxide or sulfide or chloride, which is maintained in position more effectively than fatty acids. However, these films are formed only as a consequence of heat generated by the working of the metal and by friction, and sometimes are formed too late in the process to do very much good. In addition, they are quite thin, because of the short time at the high temperature at which they form, and are readily displaced.

Rust or "sull" coats represent an effort to obtain thicker inorganic undercoats and while such films are usually thick enough, they tend to be displaced at higher drawing speeds and can be used only under more limited conditions. The use of rust coatings is more effective than the methods previously mentioned for very severe operations but, in addition to poor adherence, it suffers from the additional difficulty that rust coatings tend to change on aging and become abrasive after storage for several days.

In conformance to the general principle that dissimilar materials tend to stay away from one another, the use of metals such as copper or lead on steel provides another means of reducing welding between the work and the die. This is frequently very effective, is especially desirable because of the ductile nature of the coating metal but is usually avoided because of the expense involved in applying the dissimilar metal to the surface. Thus, in order to be effective copper must be plated electrolytically and lead must be applied by means of immersion in a molten bath with all the attendant hazards. The copper coating obtained by immersion in an acid copper solution is suitable for

milder drawing conditions, but is usually too thin for severe drawing operations since the surface of the metal is extended and the coating becomes too thin to prevent contact.

Another method that has been used widely for severe drawing operations involves the addition to an oily or emulsion type lubricant of an inorganic filler or pigment, which is designed to keep the surfaces from coming too closely together since the pigment is trapped between the surfaces. This method has been useful in many cases, but suffers from the disadvantages of the haphazard nature of the entrapment of the filler between the surfaces and the necessity for maintaining it in dispersion, since most fillers tend to settle out rapidly. Thus, there is the difficulty of preventing the filler from clogging pump lines, moving parts, etc. Pigmented lubricants also suffer from the disadvantage of producing a mottled surface on the steel where the filler is ground into the surface during the forming operation. In spite of these disadvantages, inorganic materials such as these fillers or rust coatings have been widely used in severe metal forming operations because nothing else has been available to do the job effectively.

In phosphate coatings we have a material very similar in basic nature to the materials just described, but offering certain very definite advantages. Thus, the phosphate coating may be considered as a pigment or filler that is maintained in position at just the areas where it is required so that it can act as an effective separator of the steel parts, preventing welding and galling. The high adherence of phosphate coatings obtained from properly designed phosphatizing solutions permits it to withstand the shearing stresses at the die, and thus perform its function of separating the surfaces very effectively.

The phosphate coating during its passage through the die is converted into an amorphous or glassy condition. This may be seen in Figure 2, which represents a plastic replica of a phosphated surface after it has been drawn. This photograph may be compared with Figure 1 where the zinc phosphate is in highly crystalline condition. The glassy phosphate coating obtained after a drawing operation is of particular interest because it has been found possible in many cases to draw metal a second or third time and still have this coating provide metal-parting properties as well as lubrication due to the organic lubricant present. This is possible, of course, only if the coating is sufficiently thick prior to the first draw so that the extension of surface during the drawing operation does not reduce this thickness to an insufficient quantity. The glass-like phosphate coating which remains can be removed by a mild pickling operation or by an alkali treatment to yield the basic metal surface, or it may be permitted to remain on the surface after superficial degreasing and thereby provide a certain measure of corrosion resistance, in addition to a glossy surface.

In addition to the separating action provided by a phosphate coating, a supplementary lubricant is required to reduce rubbing friction. Emulsion, soap or oily lubricants containing fatty acid are used for this purpose. Fatty acids are adsorbed on metal surfaces in such a way that the surfaces can slide over one another with the hydrocarbon tails of the lubricant molecules acting to reduce friction. The manner in which polar lubricants,

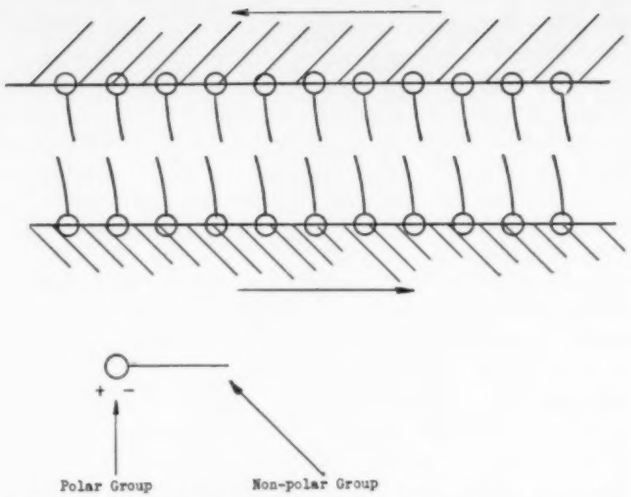



**Figure 3 — Sketch shows how polar lubricants reduce rubbing friction.**

such as fatty acids, act to reduce rubbing friction may be visualized more readily by examination of Figure 3. While this is of limited effectiveness in preventing welding and galling, it is of great effectiveness in reducing rubbing friction. Of course, the reduction in rubbing friction becomes of importance only when the surfaces are separated to such an extent that welding cannot occur.

As mentioned previously, the phosphate coating is used in conjunction with an emulsion lubricant. It is highly desirable to select lubricants so as to be compatible with this coating, not only with regard to lack of harmful effect, but also in terms of a chemical reaction between the phosphate coating and the lubricant to securely anchor the lubricant in position.

While there is a certain probability of interaction between the lubricant and the phosphate coating, it has been found desirable under many conditions to provide a chemical rinse between the phosphatizing process and immersion in the organic lubricant. This modifies the surface of the phosphate coating to some extent making it more reactive, so that when it is immersed in the lubricant, a rapid chemical reaction takes place between the zinc of zinc phosphate and the fatty acid residues in the organic lubricant with the formation of soaps and partial soaps. This frequently makes a substantial difference in the overall performance of the process.

After this general description, an obvious question would be: How is the phosphate coating applied, and also with what metals and under what conditions can it be used?

Frequently two solutions are supplied for the preparation of the phosphatizing bath; one of these solutions is then used continuously to replenish the bath and maintain it at the proper concentration. A chart is provided which permits calculation of the quantities of materials required to make up and replenish the bath, usually a bath is of the order of a 2 per cent solution of the concentrate dissolved in water. The major portion of the water is put into the tank, the tank heated to approximately the correct temperature, and the concentrates poured into the tank in such a way as to insure uniform distribution. Previously it had been necessary to run through a certain amount of scrap iron in order to condition the bath before use; it is now possible to add

a relatively small amount of a breaking-in salt, in powder form, following which work can be processed immediately. The baths are generally used at a temperature of 160-180 F and are heated with steam coils arranged along the side of the tank, because during the operation of a phosphatizing bath, a certain amount of insoluble material or sludge is formed which settles to the bottom of the tank. The working volume of the tank should be no more than two-thirds the size of the tank, one-third of the tank being reserved for the settling of this sludge. The sludge is removed periodically depending upon the volume of work being processed. In most cases, it is not necessary to do this more frequently than once a month.

The concentration of the bath is determined by a simple titration usually performed once a day by the pickle house operator. A chart is provided from which the operator determines, from the results of the titration, how much of the replenishing solution has to be added to the tank in order to maintain it at strength. Concentration is expressed in terms of points which represent the number of cubic centimeters of 0.1 N sodium hydroxide required for a 10 cc sample of the bath, using phenolphthalein as an indicator. Phosphatizing baths are used at anywhere between 20 and 35 points depending upon the application.

Work is processed for from 2 to 7 minutes; frequently the time required to obtain a desired coating thickness can be modified by adjustment of the bath to meet plant conditions. Phosphate coatings for use in metal forming are most frequently obtained by immersion of the articles in the solution, but it is also possible to obtain reasonably good phosphate coatings by low pressure spraying of the solutions. For most severe forming operations, however, it is recommended that the bath be used as an immersion bath because the heaviest and most adherent coatings can be obtained by this technique. Equipment for phosphatizing may be made of mild steel. It is frequently desirable, however, to have the steam coils prepared of stainless steel since these are subjected to the most severe conditions. The consumption of chemicals in this process is determined to a considerable extent by the thickness of coating required for the specific application, but since more severe drawing operations or multiple draws can be accomplished with heavier coatings, it is a practical economy to use the thicker rather than the thinner coatings except in isolated cases.

The lubricant baths are maintained in the customary fashion. An occasional analysis for free fatty acid and fatty matter content are usually the only controls required. Baths are available which remain stable at temperatures of 140-190 F, for a year or more and, in general, it has been found possible to use lubricants in conjunction with phosphate coatings at much lower concentrations than has been possible heretofore with other types of lubrication. Since oil base or emulsion lubricants at high concentrations are relatively expensive, this reduction in the cost of lubricant compensates to a reasonable extent for the cost of phosphatizing the surface.

The application of phosphate coatings to steel is limited to some extent by the alloy content of the steel. In general, austenitic steel will not take a coating. It has not been found possible successfully to put an adequate phosphate coating on steels with a chromium content higher than 10 per cent, and intermediate alloys with chromium contents of 3 to 8 per cent are found to yield thinner phosphate coatings than plain carbon steels. This may be compensated for to some extent by increasing the time of contact of these medium alloy steels with the phosphatizing solution. The thin phosphate coatings can be compensated for in another fashion by the use of special lubricants. It should be borne in mind, however, that performance under these circumstances is far superior to that which might be obtained by the use of the lubricant alone.

Good coatings are obtained on plain carbon steels and the lower alloys over a wide range of conditions. It can be considered that a higher carbon content of the steel generally results in a heavier phosphate coating. The thickness of the phosphate coating obtained for various steels may be modified by variation of the concentration, time and temperature within reasonably broad ranges, and the manufacturer's recommendations in these respects are frequently all that are required for the process to be set up to function properly in the customer's plant.

It may be seen, therefore, that the use of phosphate coatings on steel for severe drawing operations combines excellent lubrication with ease of application. The solutions are dilute and not particularly corrosive; there are no obnoxious odors involved; control of the solutions is relatively easy; and the process is economical especially in the light of things that can be done with metal treated by this method. The application of these coatings to various industries and the effects which have been observed under these conditions, are given in the second part of this article.

## *Part 2 - Application*

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▲ PHOSPHATE coatings represent just one type of the numerous metallic or salt coatings which are physically or chemically produced on metal surfaces which aid in severe cold forming operations. These coatings are widely used in the metal fabricating industry.

Examples of coatings which are "physically" deposited are lime or borax films. Examples of coatings which are "chemically" produced are oxide films. Some of the common metal coatings, such as copper and lead, are typical examples.

Phosphate coatings as an aid to facilitate cold forming were used first in Germany. In the year 1934, Dr. Fritz Singer of Germany applied for a patent to phosphatize steel articles and, subsequently, subjecting them to cold forming operations.

The advantages of phosphate coatings, compared with salt coatings, are: uniform composition and constant physical properties, produced in baths, which can be controlled easily. They possess enhanced separation

power, very satisfactory anti-welding properties and excellent "carrying through" through the die under high pressure.

The application of phosphatizing is limited to those metals which are readily attacked by dilute phosphoric acid at elevated temperature, such as ferrous metals of ferritic structure: straight carbon steel and low alloy steel, aluminum and its alloys, zinc and zinc alloys. Ferrous metals of austenitic structure such as stainless steel cannot be phosphatized.

The following advantages of phosphatizing for cold forming operations open a broad application in the steel industry:

a. Increased die life.
b. Higher drawing speeds.
c. Greater single reductions.
d. Elimination of some annealing operations.
e. Prevention of scoring, galling and pick-up.
f. Smooth finish.
g. Affords improved corrosion resistance.

Before typical fields of application of phosphate coatings are discussed, the main objective of this presentation, some data should be presented which should aid in understanding the effectiveness of phosphate coatings. As we all know, the higher the stresses in the dies, the more important is adequate lubrication. In other words, lubrication becomes more of a problem with increased unit pressures necessary to perform a specific press operation.

The total stress applied in the cold working of metals is the sum of:

a. The stress necessary to overcome the flow resistance of the metal (internal friction) which is dependent upon the composition and the physical properties of the metal.
b. The stress necessary to overcome the frictional resistance (external friction) occurring between two sliding surfaces.

Therefore, any measure which reduces friction will facilitate the cold working process. Hence, the knowledge of the degree of friction is of considerable value in cold forming. Table I shows the apparent coefficients of friction applying various unit pressure on carbon steel, for both uncoated and phosphatized surfaces.

**TABLE I**

**Lubricant: Diluted fat-soap-emulsion applied by soaking:**

**a. At 85 F for a few seconds**
**b. At 160 F for one hour**

| Unit pressure, psi | Immersion time | Temperature, F | Apparent coefficient of friction | |
|---|---|---|---|---|
| | | | Uncoated | Phosphatized |
| 10,000 | few sec | 85 | 0.114 | 0.070 |
| | 1 hr | 160 | 0.108 | 0.013 |
| 50,000 | few sec | 85 | 0.081 | 0.076 |
| | 1 hr | 160 | 0.068 | 0.032 |
| 100,000 | few sec | 85 | 0.086 | 0.066 |
| | 1 hr | 160 | 0.057 | 0.043 |
| 200,000 | few sec | 85 | 0.084 | 0.062 |
| | 1 hr | 160 | 0.070 | 0.043 |

The phosphatized surface gives a considerably lower coefficient of friction than the uncoated surface.

Longer soaking time at elevated temperature provides lower coefficients of friction for both coated and uncoated steel. However, the influence of time and temperature is much more pronounced on phosphatized surfaces. This fact together with the observation that an almost water insoluble lubricant film is formed under these conditions leads to the conclusion that a chemical reaction takes place between the phosphate coating and the soap emulsion (formation of zinc soaps). Such a reaction is naturally enhanced by time and temperature. Indicative of such a chemical reaction is the amount of lubricant adsorbed, varying time and temperature, as shown for a phosphatized surface in Table II.

**TABLE II**

**Lubricant: 1 per cent sodium stearate solution**

**Surface: Phosphatized**

| Immersion time | Temperature, F | Weight of lubricant film, gm/ft² |
|---|---|---|
| Few seconds | 65 | 0.070 |
| Few seconds | 160 | 0.090 |
| One hour | 65 | 0.150 |
| One hour | 160 | 0.740 |

Table III gives a comparison of the apparent coefficient of friction on uncoated and phosphate coated steel, using three types of lubricants.

**TABLE III**

**Lubricant A: Diluted fat-soap emulsion: 160 F for one hour**

**Lubricant B: Fat-soap paste, pigmented (chalk)**

**Lubricant C: Solid calcium stearate**

| Unit pressure, psi | Apparent coefficients of friction | | | | | |
|---|---|---|---|---|---|---|
| | Lubricant A | | Lubricant B | | Lubricant C | |
| | Uncoated | Phosphate coated | Uncoated | Phosphate coated | Uncoated | Phosphate coated |
| 10,000 | 0.108 | 0.013 | 0.093 | 0.052 | 0.055 | 0.024 |
| 50,000 | 0.068 | 0.032 | 0.100 | 0.080 | 0.086 | 0.064 |
| 100,000 | 0.057 | 0.042 | 0.090 | 0.074 | 0.079 | 0.069 |
| 200,000 | 0.070 | 0.043 | 0.078 | 0.065 | 0.061 | 0.045 |

Here again, phosphatized steel gives lower frictional resistance than uncoated steel.

Table IV gives the apparent coefficients of friction of various phosphate coatings.

**TABLE IV**

**Lubricant: Diluted fat-soap emulsion: 160 F, one hour**

| Unit pressure, psi | Apparent coefficients of friction | | | |
|---|---|---|---|---|
| | Uncoated | Zinc phosphate | Manganese phosphate | Cadmium phosphate |
| 10,000 | 0.108 | 0.013 | 0.085 | 0.034 |
| 50,000 | 0.068 | 0.032 | 0.070 | 0.069 |
| 100,000 | 0.057 | 0.042 | 0.059 | 0.055 |
| 200,000 | 0.070 | 0.043 | 0.066 | 0.055 |

Notice that the zinc phosphate type coating provides the lowest frictional resistance.

Table V shows the reduction in cross-section area in

**TABLE V**

**Lubricant A: Diluted fat-soap emulsion: 160 F, one hour**

**Lubricant B: Solid calcium stearate**

| Lubricant | Reduction in cross-section area, per cent |
|---|---|
| A | 52.5 |
| B | 47.0 |

drawing SAE 1010 using two types of lubricants in combination with a phosphatized surface, applying a unit pressure of 200,000 psi.

1. *Stampings* — The stamping industry rarely requires a lubrication system such as is given by phosphate coatings in combination with a lubricant. The unit stress in the tool averages 5000-10,000 psi. Wet lubricants of the fat-soap emulsion type either unpigmented or pigmented, usually applied directly at the press, satisfy the requirement of the stamping industry. These lubricants are inexpensive, easily applied and readily removed. For more difficult stampings wherein the concentration of stresses is confined to particular areas, which causes scoring and pick-up, dry soap or wax films do an excellent job. However, in some instances the application of a phosphate coating may be necessary as is illustrated by the following example. Considerable difficulties were experienced with a tub for an automatic washing machine. This tub is formed from a blank in four or five operations on one press. On the second redraw die (sleeve die) particularly, severe pick-up occurred, necessitating stoning of the die after each three or four pieces. A dry soap film decreased pick-up somewhat; however, this was not satisfactory either. Phosphatizing of the blanks eliminated pick-up and consequent stoning operations completely. Production could be increased 100 per cent and more which fully justified the phosphatizing costs.

Attention should be called to the fact that the press must be adjusted to the phosphate lubricant system, otherwise breakage or too shallow draws, or both, are experienced. Frequently the blank holder pressure must be increased if phosphatized blanks are to work satisfactorily.

2. *Wire Drawing* — It may be of interest to present some comparative results obtained for lime coated and phosphate coated wire, using a dry soap-lime lubricant. These results are indicative of what can be expected from phosphatizing for other severe cold forming operations where appreciable reduction in cross-section area occurs. To secure reliable results, the coils, 400 pounds each, were rolled from a single ingot of steel.

Steel analysis, per cent:

C — 0.67
Mn — 0.70
P — 0.013
S — 0.030
Si — 0.20

Eighteen coils were phosphatized and 18 coils lime coated (2 lime dips) and drawn with a speed of 800 fpm on the same continuous drawing machine through 4 die holes (tungsten carbide dies) with a total reduction of approximately 75 per cent and single reductions per pass of about 30 per cent. Only the first die (ripper die) was lubricated. For each treatment a new set of dies was used.

The die life was approximately two to three times greater in the case of the phosphatized wire than for the line coated wire.

Table VI shows the physicals obtained:

**TABLE VI**

**Wire drawn from 0.218 to 0.109 in. diam**

| Treatment | Average | | Reduction in area, per cent |
|---|---|---|---|
| | Tensile strength, psi | Elongation, per cent | |
| Lime coat | 229,570 | 5.25 | 48.15 |
| Phosphate coat | 226,850 | 5.5 | 49.3 |

These results are of interest since it is usually assumed that the physicals obtained depend exclusively on the amount of cold working.

Table VII gives the corrosion resistance of the final

**TABLE VII**

**Salt spray: 20 per cent NaCl at 110 F**

| Coating | Rust—gm/ft² |
|---|---|
| Lime | 2.52 |
| Phosphate | 1.42 |

drawn wire whereby the amount of rust was determined after exposure of 24 hours to salt spray.

To establish some quantitative data about the relative value of the two lubrication methods, the same wire was drawn to No. 6 wire (0.183 in. diam) patented and then drawn through three die holes on a single

**TABLE VIII**

**Drawing speed: 350 fpm**

| Diam before and after, in. | Per cent reduction | Theoretical die pull | | Actual die pull | | Frictional load | | Unit stress | | Power kw | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lime, lb | Phos, lb | Lime, lb | Phos, lb | Lime, lb | Phos, lb | Lime, psi | Phos, psi | Lime | Phos |
| 0.183-0.153 | 29.0 | 1058 | 1035 | 1543 | 1438 | 485 | 393 | 195,000 | 182,100 | 15.83 | 15.25 |
| 0.153-0.129 | 29.4 | 840 | 849 | 1155 | 1097 | 315 | 248 | 217,000 | 206,500 | 12.69 | 12.36 |
| 0.129-0.109 | 28.5 | 652 | 655 | 875 | 873 | 223 | 218 | 233,600 | 233,300 | 10.13 | 10.25 |

drawblock. The drawing machine was equipped with a kw-meter to determine the power consumption and a dynamometer to determine the die pull. The theoretical die pull, i.e. force to overcome the internal friction, was calculated from the mean tensile before and after reduction. The results are summarized in Table VIII.

It can be seen that the die pulls for phosphatized wire are considerably lower than those for lime coated wire, indicating a decrease of approximately 20 per cent for the first two dies.

**TABLE IX**

**Surface phosphated, Lubricant: Dry soap-lime**

| Diam before and after in. | Speed fpm | Theoretical die pull, lb | Actual die pull, lb | Frictional load, lb | Efficiency,* per cent |
|---|---|---|---|---|---|
| 0.183—0.154 | 1.4 | 1045 | 1800 | 755 | 58.0 |
| 0.183—0.154 | 343 | 1045 | 1470 | 425 | 71.0 |
| 0.183—0.154 | 580 | 1045 | 1450 | 405 | 72.0 |
| 0.155—0.130 | 1.4 | 840 | 1450 | 610 | 58.0 |
| 0.154—0.130 | 347 | 840 | 1127 | 287 | 75.0 |
| 0.154—0.130 | 730 | 840 | 1090 | 250 | 77.5 |
| 0.130—0.108 | 1.4 | 658 | 1130 | 472 | 58.0 |
| 0.130—0.109 | 353 | 658 | 893 | 235 | 73.8 |
| 0.130—0.109 | 745 | 658 | 860 | 202 | 76.5 |

$$*\text{Efficiency} = \frac{\text{theoretical die pull}}{\text{actual die pull}} \times 100$$

Table IX shows the influence of speed on frictional conditions and efficiency.

As already mentioned, the data presented should be considered as indicative of the effectiveness of phosphatizing, generally speaking. Whether the application of phosphate coatings for dry wire drawing is economical or not must still be established because the advantages of phosphatizing for this application cannot be utilized completely. The drawing speeds of most continuous wire drawing machines are limited and lime or borax coated wire may be drawn uneventfully at these speeds. Greater single reductions than 30 per cent are frequently not desirable in order to meet certain physical requirements, such as torsion. Pick-up is seldom experienced when drawing round wire.

An excellent application of phosphatizing may be in drawing odd shaped wire, where pick-up frequently occurs.

A completely different picture is the drawing of finer wire on continuous wire drawing machines, using wet lubrication by circulating a dilute lubricant which floods the die holes. This technique gave this cold forming process the name: wet wire drawing. The high speeds applied utilizes the excellent cooling and full benefits afforded by a suitable lubrication system.

The application of phosphatizing in this field offers the following advantages:

a. Increase in speed of 40 per cent or more.
b. Two to five times higher die life.
c. Decreased lubricant consumption.
d. Enhanced corrosion resistance of the wire.
e. Smoother finish and excellent appearance.
f. Cleaner mill.

An interesting field of phosphatizing is manufacturing of screws and bolts. These screws and bolts are produced from predrawn rods by cutting and upsetting. Phosphatized rods eliminate pick-up and scoring, frequently experienced with lime coatings and provide an excellent smooth finish and high die life.

3. *Tube Drawing* — In manufacturing seamless cold drawn tubes, phosphatizing is a well established lubrication technique. The reason for that is the fact that the tube industry was able to make extended use of the benefits of this excellent lubrication method. The normal technique necessitated annealing after each pass. Phosphate coatings enabled the tube industry to eliminate or minimize considerably inside diameter and outside diameter pick-up. The drawing speed could be increased considerably, sometimes several times.

Higher single reductions are possible. Even annealing operations may be minimized. All these advantages contributed heavily to greater production rates and decrease of scrap. An excellent smooth finish having good corrosion resistance appeals to the customer. In a few words, phosphatizing is an indispensable feature of the tube drawing industry today.

4. *Deep Drawing* — Phosphatizing in this field offers the same advantages as in tube drawing. The benefits of phosphate coatings in deep drawing as defined, producing hollow bodies with considerable reduction in cross-section area might be even more pronounced. The stresses experienced might be up to 250,000 psi in working low carbon steel and even higher in working of alloys, such as SAE 4130.

In manufacturing of hollow bodies, such as gas bottles, fire extinguishers, etc., substantially greater reductions could be attained using phosphate coatings. The annealing operations could be reduced appreciably.

An excellent example of the usefulness of a phosphate coating is ordnance items. It could be demonstrated successfully that a steel cartridge case finished conventionally from a cup in four draws and annealing after each draw, using a dry soap film, could be made with the aid of a phosphate coating in four draws without any intermediate anneal and attaining a total reduction in cross section area of more than 80 per cent. This may not be completely feasible under mass production conditions. Furthermore, the sequence of operations depends frequently on the final physicals required. However, it is safe to state that phosphatizing in manufacturing of hollow bodies is invaluable, requiring less press operations and fewer annealing operations. Pick-up is eliminated. In addition to the foregoing, the following benefits are derived: smooth finish, high die life and good corrosion resistance.

Phosphatizing completely eliminates the difficulties which are frequently experienced when a dry soap film is exposed to high humidity at elevated temperatures. Under these weather conditions, the soap film adsorbs moisture, causing inadequate separation, leading to pick-up and breakage.

5. *Cold Extrusion of Steel* — Cold extrusion of steel becomes more and more important today. The limits of drawing are obvious since the work is under tension and its tensile completely governs the amount of reduction. Cold extrusion subjects the metal to compression, therefore, the tensile of the metal is meaningless and, theoretically speaking, metal is extremely plastic permitting reduction in cross section area per single press operation of 85 per cent or even more. However, the practical limits of cold extrusion are quite evident. They

are tool strength, friction and press equipment, because the stresses encountered are tremendous.

In cold working of low carbon steel by extrusion, pressures of 250,000 psi and higher are experienced for forward extrusions, i.e. forcing the steel to move in the same direction as the punch, and for backward extrusions pressures of 300,000 psi and higher are obtained. In backward extrusion the metal flows against the motion of the punch under compression. A typical backward extrusion is piercing a hole in a billet under compression. The biggest field of cold extrusion is the manufacture of heavy wall hollow bodies. The conventional method, which cold extrusion may replace more and more for those items (such as projectiles, rocket heads, etc.), is hot forging and machining.

It is quite evident that cold extrusion contributes tremendously in producing these articles. Starting from billets, sawn or cut off from hot rolled bars, and cupping by backward extrusion, at least 50 per cent of the metal is saved. The piece can be finished either by conventional methods, such as drawing, or finished to final length by extrusion. A general rule might be that one extrusion operation replaces two drawing operations.

However, even for hollow bodies, such as cartridge cases, cold extrusion is of considerable importance. The yield of the ingot to discs is about 35 per cent, the yield of the ingot to bar stock is about 68-70 per cent. The latter would, of course, be used to produce the cup by cold extrusion.

**TABLE X**

**Lubricant: Dilute fat-soap emulsion**

**160 F, one hour**

| Treatment | Reduction per cent | Load, psi | Remarks |
|---|---|---|---|
| Uncoated | 20 | 296,000 | Heavy pick-up |
| Phosphatized | 20 | 193,000 | .... |
| Uncoated | 40 | 232,000 | Heavy pick-up |
| Phosphatized | 40 | 208,000 | .... |
| Phosphatized | 60 | 198,000 | .... |
| Phosphatized | 85 | 260,000 | .... |

The high unit stresses makes phosphatizing indispensable in the cold extrusion of steel. Table X shows the results obtained using 1010 steel, uncoated and phosphatized, and subjected to a forward extrusion operation varying the reduction in cross-section area.

This short discussion of cold extrusion concludes this presentation of the application of phosphate coatings as an aid in cold forming. It is neither complete nor exhaustive. The possibilities of phosphatizing in the steel fabricating industry have not been fully explored by any means.

Perhaps this presentation will contribute in some small way to a broader utilization of phosphatizing in the steel fabricating industry.

# DISCUSSION

**PRESENTED BY**


**M. D. STONE, Manager Development Department, United Engineering and Foundry Co., Pittsburgh, Pa.**

**JOHN H. HITCHCOCK, Director of Research, Morgan Construction Co., Worcester, Mass.**

**S. SPRING, Research and Development Division, Pennsylvania Salt Manufacturing Co., Philadelphia, Pa.**

**MAURICE RESWICK, Engineer, Standard Oil Development Co., Linden, N. J.**


**M. D. Stone:** The thing that has impressed me is the remarkable progress that has been made in the forming of metals. In such operations, friction is extremely important — just as it is in the rolling of steel. The reduction in friction as accomplished in the sejournet process is going to be significant in that it will undoubtedly make the hot extrusion of difficult steels a commercial operation, which up till now has been more or less of a laboratory possibility.

The use of phosphate coatings for the cold extrusion of steel will likewise make this a commercial operation — specifically for the production of shell bodies, which likewise has up until now been only a technical possibility.

During World War II, shell bodies were hot formed using various types of lubricants, but most generally graphite and oil. The combination of such lubricants and hot forming kept the pressures to reasonable values. To illustrate this general point, in the rolling of thin steel strip or in the forming of thin walled shells, the friction factor can increase the pressure as much as 5 or 6 times that which would be required if friction could be made zero. Likewise in cold extrusion, the metal would flow at 60,000 psi, if no friction factor were present, but actually some 250,000 to 300,000 psi is required even with the currently best lubricants. A decrease in friction of only 20 or 30 per cent could decrease the required forces to a half or even a third in many cases.

**John H. Hitchcock:** I am particularly interested in the application of phosphate coatings for wire, for use in wire drawing processes, but I am a little confused by what appears to be a conflict in the statements which have been made. If I remember correctly Mr. Spring said that phosphate coatings in the wire drawing process can sometimes persist through the second or third draft, but that they are frequently lost in the first draft. Dr. Schuster spoke about the application of phosphate coatings to wire drawn on the multidraft machine. I think that there are probably some others who like me would appreciate an explanation.

**S. Spring:** I am sorry that I may have given the impression that the phosphate coating would not persist through more than one draft. Actually, I was interested in stressing the fact that it could and would persist through many drafts, and in the drawing of wire it actually persists through as many as nine drafts through decreasing diameter dies.

**Maurice Reswick:** The first speaker mentioned glass as a lubricant, presumably for high-temperature applications, so I presume the speaker who followed confined his remarks to cold-drawing of metal.

**S. Spring:** Yes, that is correct.

# Differential Thickness Coating

# ON ELECTROLYTIC TINPLATE

By S. S. JOHNSTON
Technical Director
Electrolytic Department
Weirton Steel Co.
Weirton, W. Va.

***. . . . differentially coated tinplate is not only economical, but it conserves the supply of strategically needed tin . . . .***

▲ BECAUSE of its relationship to American food processing and uses, tin is one of the most strategic metals. Very few deposits occur on the North American continent and even the chief of these are in Canada. The sudden outbreak of war in the Pacific, late in 1941, created a major crisis in the use of tin. Inventories were short and the mines and smelters which produced 72 per cent of the world's tin were soon in enemy hands.

The government assumed control of existing stocks and, through the War Production Board, allocations of these stocks were made to food processing, industrial and military needs.

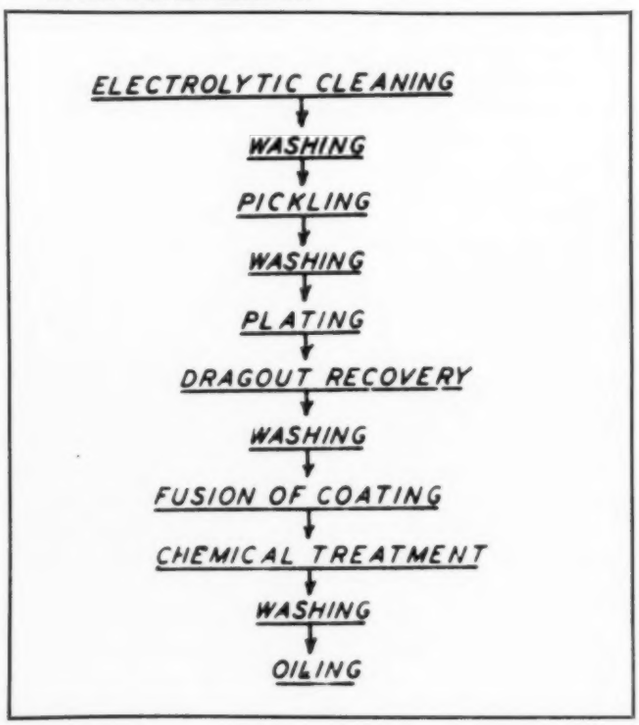
One obvious method of stretching tin allocations for tinplate was to replace, wherever possible, hot-dip tinplate with the electrolytic material in the process food container field. Steel shortages, caused by war needs, forced many foods out of metal containers altogether. Intensive co-operative research by the can-makers and the steel industry resulted in substantial tin savings by using electrolytic tinplate for many products still permitted to be in metal containers.

It is worthy of note that, while several pilot electrolytic lines were in existence on December 7, 1941, there was not one commercial high-speed line in operation. Early in 1943, all major tinplate producing steel companies had at least one unit in operation to participate in the tin saving program. It is a tribute to American ingenuity and resourcefulness that several distinct and diverse types of lines were developed to produce the same product — electrolytic tinplate.

Prior to the war, less than 5 per cent of the hot-dip tinplate used received a sanitary enamel, and these were specialized cases. With the lighter coating weights applied to electrolytic tinplate, it was found that supplemental organic coatings were necessary to obtain maximum corrosion resistance. Surface treatments and organic coating formulation and application became a major field of research.

After war's end, steel for domestic use became more plentiful although tin mines and smelters were several years getting back to normal operations. With tin still in short supply, research efforts were redoubled to apply electrolytic coatings in place of hot-dip plate. Where 0.50-lb per base box coatings had been almost universally used, it was found that many of these could be supplanted with 0.25-lb coatings and use the same lacquer systems. Plain cans with 0.75-lb per base box have supplanted hot-dip plate in many applications,

**Figure 1 — Flow sheet of operations in acid electrotinning at the Weirton Steel Co.**



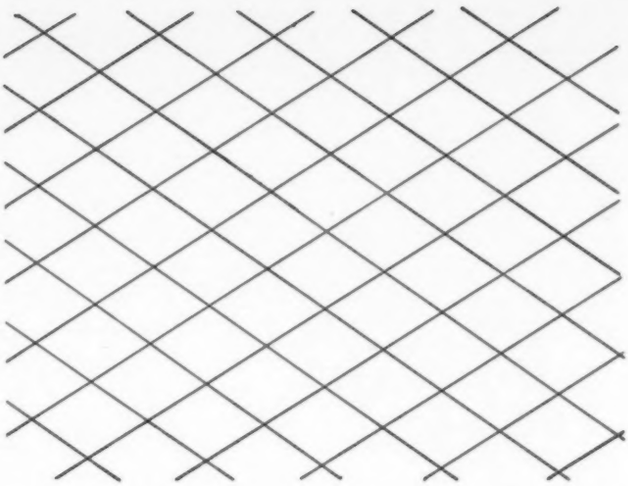


**Figure 2 — Reduced size diamond mark on differentially coated electrolytic tinplate. Long axis is parallel to strip length.**

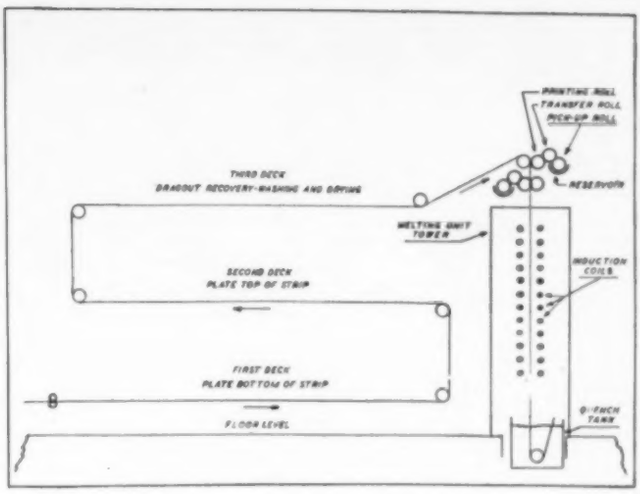



**Figure 3 — Schematic elevation view of plater.**

and plain 1.00-lb coatings have been used in some more severe applications.

Again there are political and military disturbances in the Far East. While there has been no cessation of tin production or shipment, there is an implied threat that once again the major tin producing areas may be under the domination of powers unfriendly to the United States. In addition, unsettled world conditions have caused an unwarranted and unhealthy price fluctuation of tin. In June 1950 the spot price of tin was $0.76 per pound. Eight months later, in January 1951, the price was $1.83 per pound. The current price of $1.03 per lb (October 4, 1951) to United States industry is pegged under the world price. These price fluctuations highlight our helplessness and dependence on other sources for a vital commodity.

Unprecedented demand for tinplate and other products requiring large amounts of tin, since war's end, has precluded the possibility of building up an adequate reserve against the very world situation confronting us today. As a consequence, caution and good sense demand that current imports be judiciously allocated, part to current manufactures and the rest to inventory against possible future curtailment in receipts. Needs of an expanded, mechanized defense organization require an expanded allocation and this is a must. The tinplate and canning industry must bear the brunt of a reduction in the consumption of tin. There are methods by which most of their needs can be met, even in the face of drastic reduction.

Corrosion engineers have long taken advantage of special properties of different materials in solving their problems. An acid tank, for example, might be made of mild steel for strength, lined with rubber or lead to resist attack by the acid and painted on the outside to resist atmospheric attack. It is just as logical to design a food container with an internal tin coating thickness sufficient to resist the attack of specific foods and an outer coating thickness to withstand ordinary atmospheric conditions encountered in storage.

The Weirton Steel Co. in its electrolytic tinplate process, developed a horizontal type plater in which each side of the strip is plated independently of the other. Thus by the simple adjustment of several rheostats, any desired coating thickness may be applied to either side of the strip. Many combinations of present commercial coating weights (which have the same thickness on both sides) are possible. These differential coatings can effect a real saving in the amount of tin applied, over conventional methods. These savings may, in whole or in part, be used to coat more area, as may be seen in Table I.

After production of a differentially coated sheet, proper identification of the two sides presents a difficult problem. Not only must the sheet marking be readily identified, but any can component formed from it must also bear some distinctive device. Definition of the problem allows the following general prerequisites of a marking or identification system to be stated:

1. The side bearing the least coating should have the identifying device.
2. The entire side of the sheet should be covered and, if marks are used, they should be no further apart than one inch.

**Figure 4 — Coils ready for plating. Center coil is feeding to the plating line. Coil on left is ready to weld on to end of coil being plated. Coil on right is ready to replace coil being plated.**

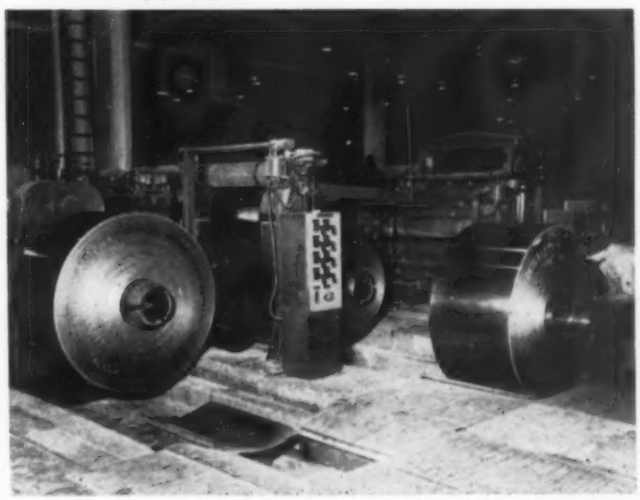


Figure 5 — Alkaline cleaning tank in foreground is followed by scrubber unit and immersion pickle tank.

Figure 6 — Main operating control board. Tower in foreground is melting unit. Marking device is mounted on top of this tower.

TABLE I

New Electrolytic Tin Coating Data Sheet of Weirton Steel Co.

| 0.25 lb Basis one side<br>0.50 lb Basis reverse side | In lieu of 0.50 lb basis both sides |
|---|---|
| Average coating | 0.375 lb |
| Metal savings per base box | 0.125 lb |
| Metal savings—Per cent | 25.0 per cent |
| Increase in area | 33.3 per cent |

| 0.25 lb Basis one side<br>0.75 lb Basis reverse side | In lieu of 0.75 lb basis both sides |
|---|---|
| Average coating | 0.500 lb |
| Metal savings per base box | 0.250 lb |
| Metal savings—Per cent | 33.3 per cent |
| Increase in area | 50.0 per cent |

| 0.25 lb Basis one side<br>1.00 lb Basis reverse side | In lieu of 1.25 lb basis both sides |
|---|---|
| Average coating | 0.625 lb |
| Metal savings per base box | 0.625 lb |
| Metal savings—Per cent | 050.0 per cent |
| Increase in area | 100.0 per cent |

| 0.375 lb Basis one side<br>1.00 lb Basis reverse side | In lieu of 1.25 lb basis both sides |
|---|---|
| Average coating | 0.6875 lb |
| Metal savings per base box | 0.5625 lb |
| Metal savings—Per cent | 45.0 per cent |
| Increase in area | 81.8 per cent |

| 0.50 lb Basis one side<br>1.00 lb Basis reverse side | In lieu of 1.25 lb basis both sides |
|---|---|
| Average coating | 0.750 lb |
| Metal savings per base box | 0.500 lb |
| Metal savings—Per cent | 40.0 per cent |
| Increase in area | 66.7 per cent |

| 0.50 lb Basis one side<br>0.75 lb Basis reverse side | In lieu of 0.75 lb basis both sides |
|---|---|
| Average coating | 0.625 lb |
| Metal savings per base box | 0.125 lb |
| Metal savings—Per cent | 16.7 per cent |
| Increase in area | 20.0 per cent |

3. The device must be permanent and not subject to erasure by handling, slippage or light buffing of the surface.
4. Outline of a mark should be visible but not prominent.
5. The device must not interfere with enamel adhesion or lithography.
6. The device must not mar the surface sufficient to be apparent after mending or passage through a tin pot.
7. The device must not interfere with solderability.
8. The device must not impair the physical properties of the steel.
9. The residual material of any mark must be nontoxic.

In the development of an identification system, there are at least three avenues of attack of the problem. These are:

1. To impart a pattern on the surface of the strip during the temper rolling operation.
2. To imprint a design on the matte finish and utilize the heat of fusion to make it permanent.
3. To imprint a design on the melted or final finish.

The Weirton Steel Co. did extensive work on each of these methods of approach. Each had its peculiar sets of conditions and problems. The second method, involving the melting unit, seemed the most practical and best adapted to the operation. Here again, there are three main problems:

1. Type of mark to be applied.
2. Method of application.
3. Material to be imprinted onto the strip.

The mark which was adopted is a diamond about 1 in. wide and 1½ in. long, continuously printed over the sheet (Figure 2). The applicator now in use is a 5-in. diam rubber roll with the raised diamond outlines over the entire surface. This roll bears against the strip utilizing the deflector roll, at the entry to the melting unit, as a back-up. A felt wick covers the back of the diamond roll and feeds palm oil to the roll which in turn prints the diamonds, with palm oil, onto the strip. The heat of fusion etches the diamond pattern into the surface and the most of the palm oil is volatilized.

**Figure 7 — Closeup of plater section shows electrical control panels for plating current.**

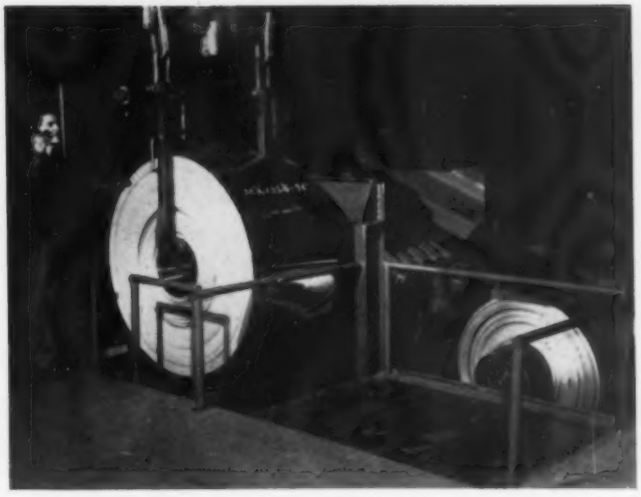


**Figure 8 — Coiling the coated strip.**

Soon to be installed is a newly designed applicator on the principle of printing rolls (Figure 3). A pick-up roll (rubber) will pick up the printing medium from a reservoir. A steel transfer roll in close proximity will take off the correct amount (according to the setting) and transfer it to the printing roll which will, in turn, print it in pattern on the strip. All rolls will be driven and synchronized with strip speed. A duplicate applicator will be provided to print the bottom of the strip when so desired. This new method of application is expected to give a uniform rate of application with a subsequent uniform mark. In addition, it will make available a wide field of printing media not now available because of feeding difficulties. Listed for early trial are sulphonated red oil, sulphonated sperm oil and oleic acid. These materials have a favorable fatty acid content for etching purposes and are entirely volatile at temperatures well below the melting point of tin.

Tin is one of the natural resources and, as such, the supply is not inexhaustible. Apart from military and economic emergency, it is clear that conservation measures in its use are in order. Ill-advised and unrestrained uses will hasten depletion and bring about a radical change in our mode of life. By measures, such as the use of differentially coated tinplate, the visible supply of tin can be greatly extended and its benefits realized in good living.

# DISCUSSION

**PRESENTED BY**

**W. F. CARTER, Director of Technical Services, Acme Steel Co., Chicago, Ill.**

**S. S. JOHNSTON, Technical Director, Electrolytic Department, Weirton Steel Co., Weirton, W. Va.**

**W. F. Carter:** I would like to ask what the line speed is and secondly, I believe you mentioned the coating of a sanitary enamel. I was wondering whether that was done in connection with this machine or in a separate operation and at what line speeds those coatings were put on.

**S. S. Johnston:** The line speed that we have at the present time runs right around 1900 fpm for the quarter and half-pound coatings. On three-quarters, of course, our speed has been 1500-1600 fpm. The pound coating runs around 1200 fpm. Of course, when we have a differential, say we are running a quarter over one pound, the line speed, of necessity, must be 1200 fpm.

As far as the enameling is concerned, that is not done in strip form. That is all done in sheet form in our operation.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**ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.**

# MODERNIZING LUBRICATION OF OLD MILLS

By WARD HOLLAND
Lubrication Engineer
Republic Steel Corp.
Cleveland, Ohio

***. . . . modernization of lubrication methods of old mills will reduce maintenance, lower production costs and increase production . . . .***

▲ THE need for modernization of lubrication equipment in steel mills is today more apparent than ever before. Production schedules, at present, do not permit shutdowns of sufficient frequency for proper lubrication by hand methods. An eight hour period or one down period per week might possibly permit the mill to be gone over hurriedly with little consideration given to the amount of lubricant applied to the moving parts. This onceover application cycle is expected to last until the next shutdown, possibly an entire week. Under the present day operating conditions of our production machinery, it is sheer folly to expect a lubricant to last for such a period of time.

Attendant hazards for personnel will not allow lubrication of the machinery during the operating cycle. Inasmuch as shutdown time to permit hand lubrication results in production delay, it must be avoided if at all possible. So too, we must avoid operating failures due to lack of lubrication. In short, consideration must be given to the selection of a satisfactory method and frequency of lubricant application which offers the least delay in the flow of product through the manufacturing process. It is mandatory to apply the correct lubricant at the required frequency of application with an absolute minimum of personnel hazard.

The great strides that have been made in recent years in the steel industry in equipping operating machinery with fully automatic lubricating systems have taken most of the guess work out of lubrication. By supplying such moving parts with an adequate amount of oil or grease, extended bearing and gear life has resulted. It has been found also that the inaccessible points of lubrication, invariably neglected when hand methods of application are employed, are covered as easily as the more accessible points. This alone has resulted in considerably lower maintenance cost and increased unit production.

When mill equipment of the older type was originally designed, little or no thought was given to the application of centralized or automatic systems. This conception of lubrication requirements stemmed primarily from low speed operations and light loads then prevalent. Hand lubrication methods were found to suffice under these conditions. In recent years, this same machinery has been speeded up several times to better meet present day requirements. This imposed an increased loading on moving parts which very often resulted in extremely critical lubrication requirements. In order to meet such contingencies it has been found mandatory to redevelop the lubricating systems from time to time as required by changes in the existing operating conditions.

Centralized systems, wherever possible, should be fully automatic as they more nearly assure that the proper proportions of lubricant are applied to the various parts of the equipment. Fully automatic lubrication will reduce the amount of personal attention needed for satisfactory lubrication. Where such systems are employed, the attention of the maintenance forces will be confined to regular inspection of the systems, including such items as oil levels, the condition of the oil in use, etc. The reduction in manhours formerly demanded for proper hand lubrication was found to be a sizable figure due to the number of, and distance between, points involved in the general layout of steel plant roll trains, blast furnace equipment, coke plant machinery, etc.

Where automatic systems are not economically feasible, the semi-automatic systems are very often utilized. As compared to manual methods of application it is found manhours are greatly reduced. It can be shown no more time will be required for a man to properly lubricate several bearings from a central point than will be required to lubricate one bearing with a hand gun. Where constantly rotating parts are encountered, which prohibit the utilization of a completely automatic system, it has been found advantageous to install portions of the conventional system which can be actuated by means of a power or hand gun. When operating conditions permit, in this manner a measured quantity can be applied to all of the respective points eliminating the untidy conditions and wastage of product noted when direct manual application of the lubricant is employed.

In some cases on older machinery the points of lubrication are so widely separated that centralized lubrication cannot be adapted economically. Hand oiling is very inefficient, inasmuch as the film of lubricant progresses from excess oil film immediately after application, to boundary lubrication as leakage occurs with

time between application cycles. As the film decreases to a point where rupture of the film takes place, wear increases. In such cases the usage of controlled feed oilers or grease cups offer considerable advantages. The conventional drip oiler, wick feed, constant level oilers and spring loaded grease cups are methods of applying lubricant in this manner.

Quite often it is found to be advantageous to install what is commonly referred to as a header line system. This entails a central pumping station with supply headers leading to the furthest extremity of application with convenient outlets spaced in such a manner as to minimize the need for re-engaging the dispensing nozzle to the supply header. Quick detachable couplings, with automatic shut-off features, offer a very simple and yet effective means of dispensing lubricant through a system of this type. The need for the lubrication attendant carrying large volumes of lubricant and heavy dispensing equipment is eliminated.

In effect the lubricant transfer is accomplished by means of a given length of flexible hose on which a suitable nozzle and coupler are installed. This offers a minimum of weight and bulk of dispensing equipment for the attendant to handle. The portable length of flexible hose and nozzle assembly is engaged with the mating coupler of the lubricant header line and by means of manually operating the nozzle, a given number of points of lubrication are covered within the limitations of the length of the flexible feed line. After all the points of coverage are completed with respect to the limitation of the given outlet on the header line, the portable length of hose is disconnected and moved to the next outlet on the header line, and the same practice followed as before until all the points in question have been serviced.

Most of the older type mill machinery was designed for oil lubrication as at that time oil was the predominant lubricant. Generally most of this equipment can be converted to grease lubrication with many advantages. Usually inadequate provision was made for convenient application of oil to the bearings and no provision for collecting the oil which leaked from the end of the bearings resulting in a messy condition. However, in some instances, buckets, which proved to be a very unsightly and inefficient method of handling the situation, were placed at points of vantage to catch the oil as it dripped from the end of the bearing. Proper application of grease, with its better retentive qualities, will result in a more efficient lubrication practice and greatly improved housekeeping conditions. Grease also offers a very effective means of sealing out the infiltrate of coolant water or mill scale with a decided increase in bearing life resulting therefrom.

In some cases it has been found that portions of modern mills can be converted to grease lubrication to advantage. A case in point would be the conversion from oil to grease as the lubricant on the bearings of scale breakers, both roughing and finishing, on a continuous hot strip mill. Originally the oiling system for the scale breakers in question was supplied from the main mill system. Due to the excessive amount of contamination involved, it was decided to divorce the scale breakers from the main system. This eliminated the heavy contamination of the main system proper, but in turn necessitated frequent oil changes which proved to be quite troublesome and time consuming. It was decided to experiment with grease, applied through an automatic system for lubrication of the scale breaker bearings. After approximately two years of service operation, the bearings have been found to be in excellent mechanical condition. It is not implied that grease could be used satisfactorily as a replacement for oil throughout the balance of the mill roll train. The feasibility of this application is apparent only where the slower speeds are involved. Where higher speeds are encountered, experience proves the heat generated cannot be removed from the work zone of the bearing sufficiently fast to permit satisfactory service operations due to the insulating properties offered by the grease film. On several of the slow speed gear trains it has been expedient to convert from oil to grease lubrication to minimize loss of lubricant by leakage which resulted in an attendant fire hazard.

The few remaining steam engines have posed quite a problem when required to meet present day production schedules. Considerable work has been necessary to improve the lubrication systems on these engines to solve the problems. Use of precision force feed oilers for cylinder oil has resulted in better control of ring wear, less carbon deposit in the valve chambers and less cost for lubricant. A complete overhaul of the circulating system, installing a proper filter, by-passing a portion of the oil through a centrifuge continuously and passing the oil through a heat exchanger before it enters the bearings have given very beneficial results. Formerly it was a continuous job to remove shims in order to compensate for wear. Since modernizing the oil system, the time has been extended to about every six weeks.

In the process of modernizing lubrication equipment, we must take a further step in preventive maintenance. This is to remove the responsibility of lubrication from the so-called oiler, usually of a lower job classification, and place it in the hands of a more highly skilled individual. This individual must be properly trained to the functions of modern systems. Also he must be properly equipped, which means proper tools and a suitable location to make necessary running repairs.

Operating personnel too must be educated to the capacities of modern systems. Generally such equipment is either looked on skeptically or as a panacea for all ills. Either view can mean failure of a system, even though properly designed and engineered, and possible condemnation of all systems unless proper education is forthcoming.

A further, and perhaps the most important step, in such a modernization program, is the establishment of a lubrication repair station and the necessary lubrication repairmen to properly cover the respective plant equipment. The shop must be equipped to make repairs on all lubrication devices and have all the necessary tools for installation work.

The repairmen, properly trained in the maintenance of all systems, must make regular inspections of all systems. These inspections will often be the means of finding trouble before it is noticed by operators and before any damage is done to equipment. Wherever possible, repairs should be made in the field, but if impossible the substitution of a spare part permits the removal of the inoperative part which can be returned

to the shop where after being properly repaired it can be held for future use.

When new installations are made by an outside contractor, the repairmen can be used in a supervisory capacity to insure proper thought is given future maintenance from the standpoint of the vulnerability of the supply lines. In this manner it is possible to minimize the number of field repairs necessitated by replacement of broken lines caused by men walking over the lines in making running repairs to the machine proper.

Such a program, as outlined, cannot be instituted overnight. It must be planned ahead and followed with utmost diligence until completed.

When the program is functioning properly more time can be given to the selection and combination of lubricants so that the number required is reduced to a minimum. One type can very often be used in a number of places where formerly a different lubricant had been used at each location.

The results of this program will be less maintenance, less down time for repairs and replacements, less waste, greater production, lower lubrication costs and an overall lower production cost.

# DISCUSSION


PRESENTED BY

WARD HOLLAND, Lubrication Engineer, Republic Steel Corp., Cleveland, Ohio

LOUIS F. COFFIN, Assistant General Manager, Bethlehem Steel Co., Sparrows Point, Md.

JAMES A. BELL, Chief Engineer, Bethlehem Steel Co., Bethlehem, Pa.

J. A. BRADY, Penola Oil Co., Detroit, Mich.


**Louis F. Coffin:** It certainly is axiomatic that you cannot lubricate a bearing unless you can get the oil or grease inside of it, and that is what the application of these various types of systems accomplish.

I would like to ask whether with the small oil circulating systems, you always use an air pressure tank as a control medium and as reserve storage.

There are, of course, other applications of automatic and single shot grease systems. One that has been applied in our plant to a considerable degree may be of interest to those who have blast furnace fired blowing engines or power engines. We recently installed single shot grease systems on practically all moving parts on reciprocating gas blowing engines, with the result of less maintenance, less mess and more time for the operators to devote to general inspection.

The system of air line spray lubrication Mr. Holland called attention to on open gearing of drives is a worthwhile application. On main line shaft bearings where the speeds and loads were such as not to permit the use of grease lubrication, we have installed sealing devices on the bearings to make it possible to use a central oil lubricating system on the drive bearings, so that we now have an installation on an old type of drive of central oil lubrication on the bearings, and air-line gear shield power spray on the open gearing.

Every steel mill maintenance man owes it to himself and to his management to see that there is no point anywhere in the steel plant that is not so equipped with any one of a number of different kinds of mechanical devices, so that every bearing gets lubrication.

**Ward Holland:** We do not use pressure tanks on real small systems. On bigger systems, the air pressure tank systems are always used. On small amounts, you can take care of that very satisfactorily.

**James A. Bell:** I would like to ask how the application of the system is made to old bearings on rolling mill tables. Assuming we have the old type reservoir, do you have a separate cap on top of this reservoir, into which you tap for pipe connection, or do you make the pipe connection into the bottom of the reservoir on the cap and force lubricant into the bushing? This would allow lubricant to get out between the cap and the brass bearing. While the best job is to make pipe connection direct to the brass bearing, this would involve replacing all brasses and would be quite costly. Was any other seal applied to the bearings to prevent loss of lubricant when forcing grease to the bearing under pressure?

**Ward Holland:** On the first application you usually drill a hole through the oil pocket and go into a nipple into your bearing. Sometimes they take a machine and take the cap off. Generally, to start with, they do not put any method of sealing on the bearing, but as they change the bearing, the design is changed a little bit.

I think the cost would be prohibitive if you went into a mill and changed your bearings all at one time to a sealing method. You have to watch the amount of grease you apply. After you once go to grease, you will have it coming out the ends, like you did the oil.

**J. A. Brady:** I know in the handling of lubricants, temperature control is a problem. I wonder if Mr. Holland would discuss temperature control and the methods he uses.

**Ward Holland:** Generally we use the soil heating cable for that. One of those, for instance, goes up the blast furnace skip. We cover it all with the asbestos pipe covering, and you can set those with thermostats; or you can control them with resistance to obtain the amount of heat you want.

With steam pressure, your lines generally give too much heat. You cook the grease in the line going up. You want to hold your temperature to about 50 F. You have to figure it out for your particular application. Using the soil cable, you keep it warm. Your grease drum is in a warm place, and therefore, you eliminate the terrific pressure you have with cold grease in your line on the way up.

**Louis F. Coffin:** There is another interesting application of single shot or automatic grease systems that we have made to lubricate thrust washers that are placed on the idler end of the table roller shafts on blooming mills. This is intended to keep the gears in mesh and is so lined up as to provide for the expansion of the table roller as it gets hot, so that when hot the gears will be in proper mesh. This consists of a pocket welded to the table girder in such a way that we drop a bronze disc into the pocket and apply grease lubricant to it.

**Member:** Are those gears open or are they closed?

**Louis F. Coffin:** Both. In most cases they are closed.

# REFRACTORIES SYMPOSIUM

*. . . . castable and rammed refractories are finding increased applications in steel plants . . . their use can particularly reduce downtime in repair operations . . . .*

## EXPERIENCES WITH CASTABLE AND RAMMED REFRACTORIES

By J. E. DEEGAN
Ceramic Engineer
Bethlehem Steel Co.
Steelton, Pa.

▲ EXTENSIVE use of rammed and castable refractories is bringing about much better service, longer life and less bricklayer hours at the Steelton plant of Bethlehem Steel Co. Ease of application, elasticity and simplicity of installation are the greatest advantages offered by the use of these materials. The scarcity of bricklayers available, which at the present time presents a serious problem in all steel mills, is the greatest cause of searching for a suitable product and a simpler application. The rammed and castable materials produced today offer a splendid solution to this problem. Care must be taken that not too much is desired in way of results obtainable.

The following are some applications at Steelton:

All reheating furnace doors are studded and rammed with a cheap ramming mixture. Laborers make the application and results are far superior to brick-lined doors.

Forge shop heating and annealing furnace doors are being changed from brick-lined to rammed doors.

Covers for steel foundry annealing furnaces are now being rammed. A great saving in brick and bricklaying hours has been accomplished in this work.

Covers for the hot metal mixer receiving snout are rammed by labor at a great saving.

The annealing furnace covers at the fabricated steel construction department were cast with a light weight insulator at great saving in cost and decreased weight on sidewalls.

The drums of the boilers in our central boiler plant are covered with a castable material. Arches in our boilers are often patched with a rammed material and some sections are always installed with a rammed material. Lintels over many furnace door openings are studded and rammed with a mix suitable to temperature and operation.

Dampers used in flues of soaking pits are cast with a super-castable material, as is the area around cinder tapholes.

The door on the electric furnace in the electrical department used for treating steel and armatures is lined with a light-weight castable material.

The best and most important use of a rammed material is in our hot blast lines at the blast furnaces. By burning away outside plate and suspending a steel support inside the remaining brickwork in a pipe, a rapid patch can be made to lining. In one case, a patch was made at a mitre in "E" furnace hot blast line in the above manner, which has been in service for three years, without any recurrence of trouble. Shut-down time for this patch was only six to eight hours.

In July, sections of all four mitres in "A" blast furnace hot blast line were studded and rammed with a suitable mix.

Possibilities for future use of rammed materials:

1. Suspended fantail noses, open hearth furnaces.
2. Open hearth furnace doors.
3. Open hearth furnace runners.
4. Open hearth hot metal runners.

## APPLICATION OF RAMMED CASTABLE REFRACTORIES IN STEEL MILLS

By ROBERT R. FAYLES
Fuel Engineer
Lukens Steel Co.
Coatesville, Pa.

▲ THE rapidly increasing use of rammed and castable refractories is one of the outstanding present trends in steel plant refractory applications. Many of these materials have been available for some years, but only within the very recent past did they begin to find widespread use in the steel industry. Apparently, there was no reason for this slow development, aside from a conservative outlook and a resistance to change on the part of masonry supervision used to dealing with bricks and mortar. Major refractory suppliers, aware of this consumer resistance and concerned with the making and marketing of more conventional types of product, have been slow in fostering the use of these materials. The

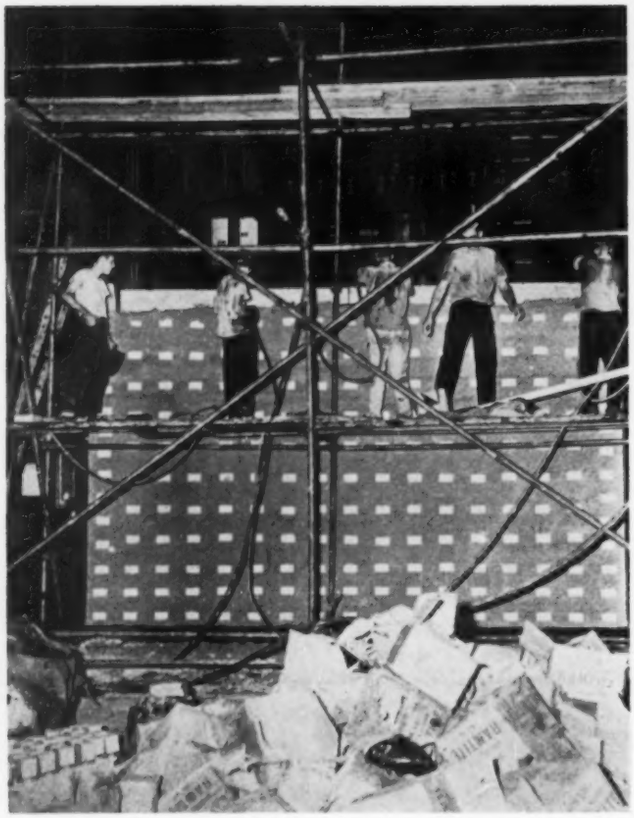


**Figure 1 — This rammed soaking pit cover was made up with the cover in the vertical position. Present practice is to do them horizontally.**

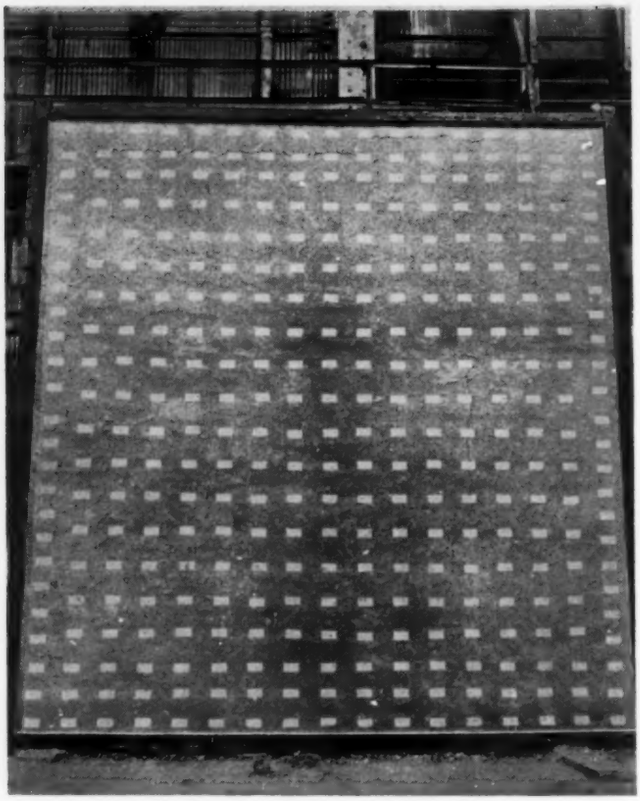


**Figure 2 — View shows completed cover which is under construction in Figure 1.**

growing awareness of the future potential of these products on the part of both major consumers and suppliers is accelerating their interest. This should bring a wider acceptance of the products, increased trials and experiments, and, inevitably, improved materials.

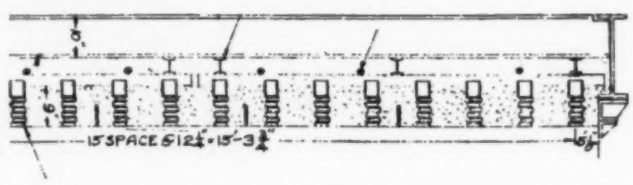
## ADVANTAGES OF RAMMED AND CASTABLE REFRACTORIES

Monolithic type refractories have several inherent advantages over brick or tile used in similar service. First, and probably most important, is the feature of being able to install such materials with unskilled labor. In these times of mason shortages, this is extremely important. We have clearly demonstrated in our plant that a quality rammed or cast job can be done by labor crews. It should be obvious that such a program necessitates much more active supervision than if craftsmen were used for the work. Based on our experience, we are using and will continue to use ordinary labor for the installing of all rammed or castable refractories. A second advantage of this type installation is the impervious nature of the finished job when properly installed. The extremely small shrinkage factors preclude much cracking and give a solid section at elevated temperatures. This minimizes air infiltration, which is of utmost importance in maintaining peak furnace performance. It also obviates the necessity of spraying or sealing which are frequently required with conventional type structures. A third advantage of monolithic materials is the simplification of inventory problems. Standardization can be achieved and costly inventories of special tiles and castings can be virtually eliminated. Storage areas can be consolidated and reduced. Physical inventory counts are more accurate and less burdensome. It also simplifies the problems of intra-plant transport, since it is not necessary to have trained personnel to load for these jobs. This is not true for many tile suspension applications where there is a variety of shapes and castings that must be accurately selected. Other minor advantages that might be cited are ease of repairing and generally lower rates of heat transfer, both of which are of importance in the maintenance and operation of all furnaces.

## ACTUAL EXPERIENCES AT LUKENS

This paper will make no attempt to deal with the ramming or castable mixes which we have used successfully for some years in our open hearth department. These include plastic chrome ore for door linings and furnace sub-hearths and high magnesia materials for

**Figure 3 — Sketch shows details of construction of a soaking pit cover.**



bottom, bank and taphole service. Only our more recent experience with the monolithic refractories will be covered.

Our first such installation was in a soaking pit cover in our 206-in. plate mill. It was on an old style regenerative pit firing natural gas and operating on a wide variety of ingot sizes. The cover had been of the "camelback" type having a sprung arch brick lining. The cover structure was rebuilt, replacing the cast side pieces with welded steel slabs fabricated in our own shops. A flat arch suspension was installed using a 6-in. lining and first quality refractory anchors. This cover went into service in March, 1948, and has been in continuous service since that time except for a very minor patch in one corner where it had been struck by an ingot. This cover now has 43 months of service and, since there is no sign of serious wear, no estimate can be made on the probable ultimate life of the lining. On the strength of this performance, two additional, identical covers were placed in use early in 1949 and have rendered equally fine results. Convinced of the merits of this type lining, we have 12 such covers in operation at the present time along with some other monolithic types that will be described later.

The first furnace roof suspension using monolithic type refractory was on a side door ingot heating furnace in our 120-in. plate mill. This was a 9-in. thick, flat suspension, covering a roof area roughly 28 ft long by 15 ft wide and requiring about 23 tons of ramming material. The 3-in. I-beams for anchoring the suspension tile were welded to the existing structure used for the former all-tile suspension. First quality clay anchors were used, being placed on 12-in. centers in each direction. The roof was rammed from each end toward the center and was completely in place in less than 24 hours. This roof went into service in July, 1950, and has been in continuous ingot heating service on carbon and stainless steels since that time. During a recent shutdown for slag removal, the roof was carefully inspected and found to be virtually intact. A few anchor tile were spalled off about an inch back from the hot face and a small roof section about 2 ft square had spalled off about ¾ in. Included as part of this roof job was a curved "bull-nose" all along the charging side of the furnace. This area had always been a troublesome maintenance spot but, with the new construction, no maintenance of any kind has been required. Two additional furnaces of the same size in the same mill have been similarly changed and are rendering equally good service. It is interesting to note that in December, 1950, we installed a regular suspended tile roof on an adjacent furnace. This was done because we did not wish to scrap the costly tile, which would have otherwise become obsolete. This furnace unit has been off five times in the intervening months, during which time roof repairs were required at each shutdown.

We have installed rammed roofs on several reheating furnaces in our various company sub-divisions during the past two years. These jobs have varied from small, portable type units to large ones having 250-300 sq ft of roof area. The largest of these was on a furnace which serves a 1500-ton press in our by-products division. The refractory material has performed quite satisfactorily, but faulty structural design due to our own oversight and a severe shock-loading by a ponderous charging mechanism, has given us some trouble. Another interesting installation was on a furnace approximately 16 by 8 ft serving another press in the same plant area. This was a rush job on which we ran out of ramming mix and had to finish out the roof with a high temperature castable. An area of about 10 sq ft in the center of the roof was cast in place and has performed in excellent fashion. We also had occasion to make a patch with castable on the furnace mentioned just previously and it gives indication of good service.

In the spring of this year we installed castable linings in 2 pit covers similar to the first one described, our first test of castables in pit covers. At the same time, a companion cover was lined with a comparatively low cost ramming mix made from pyrophillite. All these covers have been in continuous service and show very little sign of wear at this time.

**Figure 4 — The rammed cover shown in this illustration had been in service three years when this picture was taken. At time of publication this cover had been in service for five years without any maintenance.**

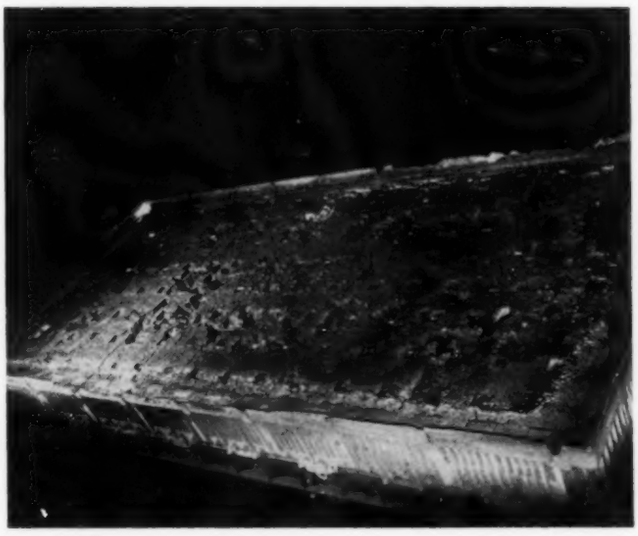


**Figure 5 — Roof shown was installed on a slab heating furnace for a hot strip mill.**

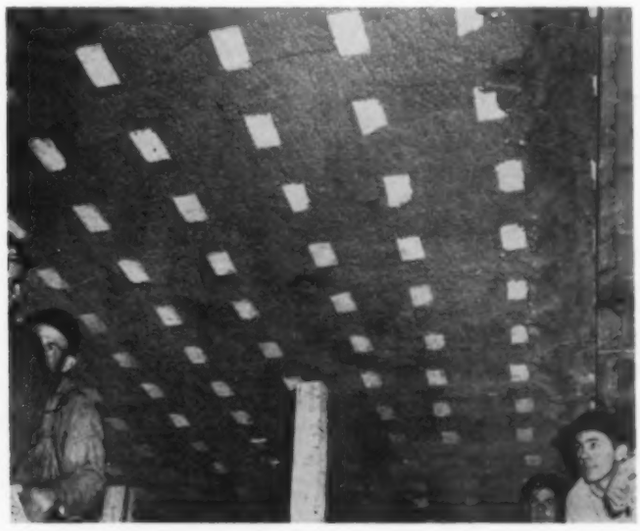


**Figure 6 — Rammed fantails and fantail noses in open hearth furnaces offer interesting applications for monolithic refractories.**

**Figure 7 — This is completed unit of furnace shown under construction in Figure 6.**

Our most interesting test of castables to date was the installation of a complete soaking pit wall except for the top 10 in. around the coping. This wall was 18 in. thick, 10 ft-6 in. high, and 9 ft long. The 3-in. I-beams for anchoring were welded horizontally to the outer steel shell on 18-in. centers. Nine-in. refractory anchors (all we had in stock) were rigidly hung in place on 18-in. centers, extending perpendicularly to the face of the wall. Wooden forms were built in place with a 9-in. offset at the base of the wall and offsets at each end of the wall to serve as skews for the headwall arches. The offset at the base of the wall was later filled with chrome-magnesite brick to act as a slag barrier. This is normal construction on all our pits, since they operate with a slag bottom practice. The entire wall was poured in a few hours and has given excellent service to date. Scars or dents resulting from ingots dragging along the wall tend to heal themselves and level over. Needless to say, we are watching this application very closely and have high hopes for its future possibilities in our shop.

The latest and possibly most intriguing application of a monolithic refractory was the installation of rammed fantails and fantail noses on one of our open hearth furnaces. This involved a major change in furnace design, since we formerly had a regular two-chamber regenerator at each end of the furnace with a 27-in. wall between the chambers. This wall extended to the slagpocket and a separate sprung-arch fantail roof was required for each chamber entrance. These fantail roofs were subjected to severe service and, although we had improved their life by using semi-silica brick, they were still a maintenance problem. This area is difficult to service and is prone to be a source of air leakage on most open hearth furnaces. We decided to install a single flat arch completely across the span formerly covered by the two arches. The division wall was removed to a point 7 ft back into the checker chambers and the cleared space in the chambers filled with checker brick. The rammed area extends around the nose of the fantail-slagpocket juncture and a short way up under the frontside uptake walls. This unit has been in service only six weeks, so it is impossible to predict the refractory results. However, it is interesting to note that the design changes have improved production rates 10 per cent and lowered fuel costs 15 per cent as compared with the same period during the previous run on the same furnace. At this writing, there is no visible damage to the rammed areas and we are extremely hopeful of obtaining long service life.

## SERVICE HINTS

Like any new process or method, there are troubles which may arise and which, usually, must be solved by actual experience. I would like to bring to your attention thoughts we have to offer based on our rather extensive experience with these newer type refractories. We have found that the design and erection of the supporting steelwork is extremely important. It does not require an elaborately designed assembly; merely one that is firm and solid. Inspect all welds and make certain that they are full and on good parent metal. This is particularly true when using existing members as part of the new design. Should a hole or crack develop, do not allow escaping flame to overheat and warp the light I-beam members. Make repairs promptly. Failure to do so may result in structural movement that will snap off the refractory anchors with loss of vital support. Do not skimp on anchor supports. There is little profit in attempting to reduce on this important item. We feel that the 12-in. center distances which we presently employ on all roof jobs is adequate and we do not plan to change.

## IMPROVEMENTS AND FUTURE TRENDS

We have definite ideas on improvements and future trends in this refractory field. First, we believe that the anchor castings can be eliminated without affecting the performance of the suspensions. Secondly, we think that the refractory anchor can be simplified and standardized as industry wide shapes. I feel that if these two suggestions are successfully followed, the present 15 per cent spread in first cost between monolithic and tile

suspensions can be virtually eliminated. An obvious further benefit would be the improved, simplified inventory problem with no castings and standard shapes.

It would seem evident, at least from our experience, that the future trend will be ever more towards castable refractories rather than the rammed types. They are simpler and more convenient in every way and give promise of excellent service in a wide variety of applications. There is every reason to believe that their temperature limits will be increased with improved products and that we are now entering a period which may ultimately bring completely cast furnace structures and an extremely varied type of precast refractory parts.

## EXPERIENCES WITH REFRACTORY CONCRETE

By WILLIAM N. HORKO

Furnace Engineer

Henry Disston & Sons Co.

Philadelphia, Pa.

▲ AS with all industrial materials, refractory concretes as manufactured today, have definite spheres of operation into which they fit. There are insulating concretes of various grades for use in places where the insulating value is of importance at various temperatures. There are also refractory concretes which are heavier than the insulating types, just as there are insulating brick and the heavier hard brick which are used for their refractory value only.

Recent experiences which we have had with this type of refractory have been very gratifying while on the other hand some experiences of the past were very disappointing.

Our use of this material has not been very diversified and has been limited to the following:

1. Burner blocks for oil fired furnaces.
2. Special purpose tile in a continuous hardening furnace.
3. Door linings in heating furnaces for bar mills, cogging and forging hammers.
4. Large annealing furnace doors.

The first two uses mentioned, namely burner blocks and special purpose tile, resulted in failure.

These blocks were 9 × 9 × 13 in. long with a 3 × 6 in. hole for use with 1¼ in. low pressure air-oil burners in a car type carburizing furnace.

Just before the burners were lighted for the first time, a strip of metal was placed in each block as shown in Figure 1 to maintain ignition during the drying out period. This is an old trick which is not always recommended but which does get results in an emergency in case of poor ignition. After several hours of operation, a small ball of carbon formed on the metal strip and caused the flame to be deflected to the sides of the block causing the temperature of the block at this point to be raised above the fusion point, resulting in failure. This incident occurred many years ago when, perhaps, the quality of refractory concrete was not as advanced as it is today. It could be said, of course, that had the ignitor not been used, failure would not have occurred. This may be true but it is a rather common occurrence to see a fuel-air jet striking the side of a block with resultant carbon formation but without thermal failure. If this occurs frequently, failure usually is due to breakage by the mechanical removal of the carbon from the block.

The second failure was of a special purpose tile which acted as a discharge chute as well as a flue cover. The design was approximately as shown in Figure 2. The material used in this case was supposed to be a cure-all for all refractory ills. A form was constructed to the shape of the tile. The material was mixed according to the manufacturer's specifications in the presence of his representative. All ingredients were carefully measured and mixed. The cast was made by high priced bricklayers. Wet bags were placed over the material and kept wet for 24 hours thereafter. Finally we could take the bags off and permit the mass to dry for several days. It was carefully placed in position in the furnace one morning. The burners were lighted and the temperature was slowly raised to the operating point. By the next morning the tile was pretty well heated. As a matter of fact, it was pretty well melted!

Because of these failures, we were not very prone to continue the use of refractory concrete. However, there were several spots in the plant where a good refractory concrete would save money for the company. These were in large annealing furnace doors where the brick movement caused by repeated expansion and contraction caused them to become loose and eventually fall out. Also, in smaller doors on furnaces which supply rolling mills, cogging hammers and forging hammers where temperature conditions and mechanical shock tend to shorten the refractory life.

I have in mind one case on a hand bar mill furnace where, because of the high temperature, the discharge door is opened just enough to permit the tongs to clear

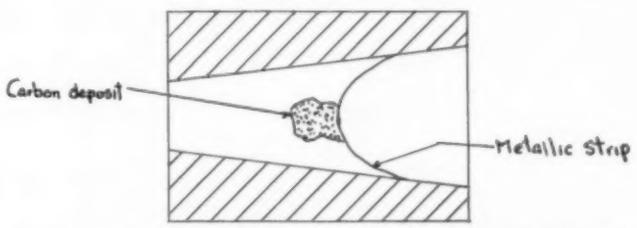
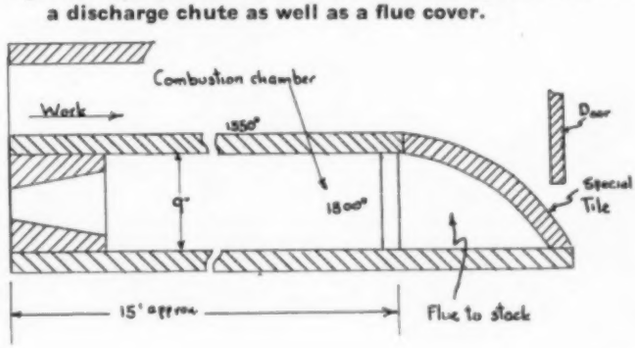



**Figure 1 — A strip of metal is placed in each block to maintain ignition during the drying out period.**

**Figure 2 — The special purpose tile was designed to act as a discharge chute as well as a flue cover.**



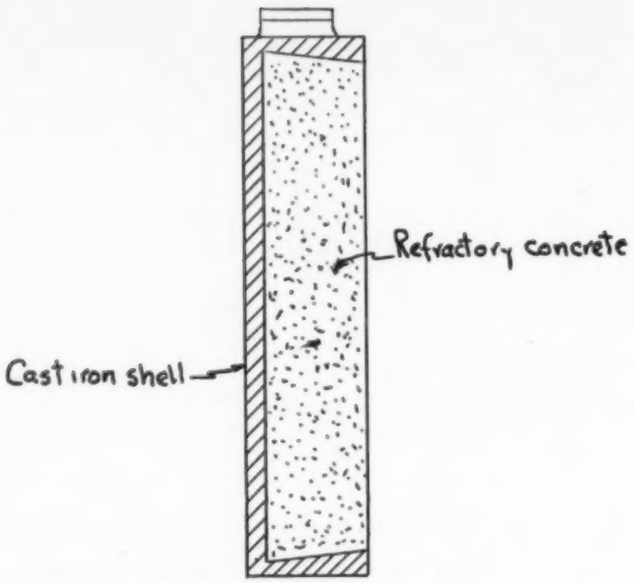
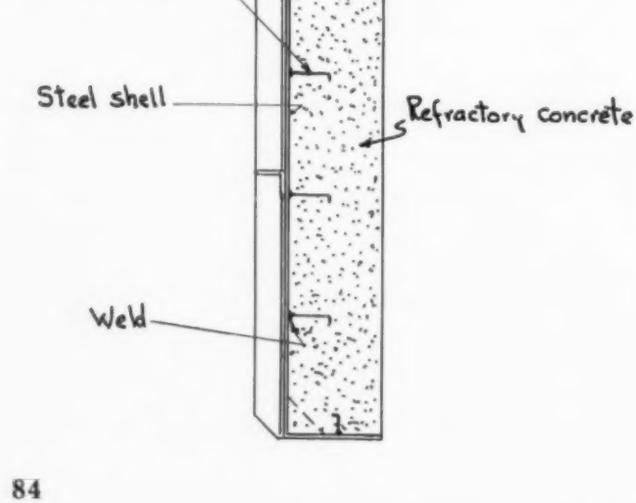



**Figure 3 — Schematic sketch of construction of cast iron door shell.**

the bottom of the door. Invariably, as the work was withdrawn, the tongs caught the bottom of the door and swung it away from the furnace. As the tongs continued their travel, the door was released and swung back against the furnace. The life of the brick lining in this door was about one week. A refractory concrete lining was installed and the life increased to approximately five months. This cast iron door shell was constructed as shown in Figure 3. The tapered sides hold the concrete lining in place but did not hold the brick lining.

In another instance, a door approximately 11 ft long by 2 ft high by 4½ in. thick gave a great deal of trouble due to the lining falling out. A steel shell was made from plate and angles with hooks from ¼-in. rod welded to the inner side to act as anchors for the refractory. The cast material is placed and smoothed with a trowel. This construction is very satisfactory and usually outlives a brick lining four to one. The construction is approximately as shown in Figure 4.

**Figure 4 — Another type of construction using a steel shell door.**




In conclusion, it can be said that our experience with refractory concrete has been very satisfactory in recent years and it can be stated generally that if the proper grade of material is used to suit the condition to which it is to be subjected and if care is used in the mixing and placing, a great many savings can be made by the use of refractory concrete.

If the early failures mentioned in this paper are compared with the many successful installations which followed, their mention serves merely to emphasize the great improvements which have been made in the manufacture and utility of all grades of refractory concrete.

## ADVANTAGES OF RAMMED AND CAST REFRACTORIES FOR STEEL PLANT USE

By R. E. WOLFENSPERGER

Refractory Engineer

Bethlehem Steel Co.

Bethlehem, Pa.

▲ THE preceding papers on this agenda have dealt with installations of rammed and cast refractories in various locations. It is the purpose of this paper to set forth not only the advantages of these two types of materials, but to present characteristics of the materials and precautions to be exercised by people using them for the first time.

The advantages of cast and rammed refractories are enumerated below:

1. Large sections can be rammed or cast in place eliminating costly brick cutting and purchase of high priced special shapes.
2. Joints, which are the weak spot in any masonry structure, can be minimized if not entirely eliminated.
3. Ease of handling.
4. A well supervised gang of laborers can do a ramming or casting job and the high cost of paying bricklayers can be eliminated.
5. Rammed bottoms in open hearth furnaces save time and fuel over the burned-in type.
6. Inaccessible locations can be reached with a castable or ramming mix shot from a refractory "gun" while the furnace is still in operation.
7. Often the design of a furnace can be simplified by use of a ramming mix or a castable.

In a discussion of this type, it is well, for purposes of clarity, to discuss the rammed and cast refractories as separate subjects.

The first subject to be discussed in detail will be fireclay ramming mixes. A ramming mix may be defined as an unfired refractory mix which can be formed, by

ramming, into a monolithic lining or a special shape. This type of mix can be compared to the raw batch in the process of brickmaking and usually consists of:

1. An inert ingredient such as grog or ground brick bats to furnish the main body and the refractory properties of the mix.
2. A plastic fireclay or blend of clays to furnish plasticity to the mix.
3. A binder or chemical which furnishes high strength in the unfired state.

Ramming mixes of magnesite, and chrome types will be disregarded in this discussion even though they do play an important part in the refractory picture in the open hearth.

Fireclay ramming mixes provide the greatest variety of applications and can be used in many installations in place of firebrick.

As a general rule, ramming mixes are sold in the wet form with the necessary water already in the mix. However, this type of material may be purchased dry. If the dry material is used, sufficient water must be added to develop the proper plasticity. Mixing and aging the dry mix develops a maximum of plasticity.

If a mix is to be rammed against forms or into molds in large sections, the person installing must be certain that no laminations are present. If a layer of two to three in. is rammed in and another layer of two to three in. is to go on top of the first layer, the first layer must be scored or roughened in order to assure the proper knitting of the two layers.

Best results are obtained with ramming mixes when they are dried slowly after being rammed in place, and then brought up to a temperature which will mature the whole mass of refractory. This is usually two or three hundred degrees above the operating temperature of the furnace in which the material is installed. It is often impossible to treat a ramming mix with this care, and if the installation is a good one mechanically, it may not be necessary. However, if a ceramic bond is not established throughout the entire mass, a plane of low strength will exist at a certain point between the hot and cold face of the material, and if the material is subject to heating and cooling cycles or vibrations of any sort, the matured or ceramically bonded portion may drop off of the main body. The presence of studs or refractory supports to within a half an inch or even an inch of the hot face of the material will aid in minimizing this difficulty.

A castable may be defined as a material consisting of a refractory aggregate plus a hydraulic setting cement. They are, in other words, refractory concretes and must be treated with more care during the curing period than ordinary concrete.

The main difficulty with refractory concretes is experienced in the temperature range from 1500 F to 2200 F where the strength is very low. It is known that one castable with a cold crushing strength of 1275 psi at normal temperatures has a cold crushing strength of under 300 psi at 2000 F.

In this range, the water of hydration in the calcium aluminate compounds in the cement is driven off and a slight ceramic bond develops. However, it is not until a higher temperature is reached that a strong ceramic bond is formed and the danger of a weak structure is passed.

In using castables, it must be remembered that the initial strength is dependent upon the complete hydration of the water and the binder, and that a weak initial strength will give a still weaker product in the temperature range of dehydration of the binder. It is a good policy to cure any castable by keeping it moist for at least 12 to 16 hours after the initial set has taken place. It goes without saying that any castable must be kept from freezing.

Castables as well as rammed materials can be reinforced by studs or refractory supports and that castables may, in addition, be reinforced with a conventional wire mesh or concrete reinforcing bars.

In conclusion, let it be stated that refractory ramming mixes and castables have a definite place in the modern steel mill. However, they must be used intelligently, handled correctly, and not expected to be a cure-all.

# DISCUSSION

PRESENTED BY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R. E. WOLFENSPERGER, Refractory Engineer, Bethlehem Steel Co., Bethlehem, Pa.

WILLIAM N. HORKO, Furnace Engineer, Henry Disston & Sons Co., Philadelphia, Pa.


**R. F. Urban:** At Sparrows Point we have not used ramming or castable materials to any large extent. We do some spraying, as Mr. Wolfensperger mentioned; if a reheating furnace roof gets a little thin we will put some of that on. We also use some on walls and this has proven very satisfactory. I think these materials should be considered a very important item, and although the cost of using cheap labor instead of the more expensive bricklayers, will definitely affect the total expenses, the true life of refractory brick should not be overlooked and every means of extending that life should be used before you extensively use castables or ramming materials.

**H. W. Potter:** With regard to rammed fantails in our open hearth furnaces, the installation was a very definite improvement, inasmuch as a dividing wall be-

tween checker chambers was a restriction to our furnaces, and infiltrated air at that point was often a problem. After the rammed construction was placed, the furnace performed appreciably better than it did during the previous run or during any recent comparable experience, so that we are very much impressed with the increased production possibilities.

Looking at this portion of the furnace from a viewpoint in the slag pocket bulkhead, after about six weeks to seven weeks use it appears to be in very good shape. There has been very little dripping of the nose, although there may well be some slag particles in the carry-over. So as far as we are concerned, it is doing a good job.

**J. D. McCullough:** Mr. Urban brought out a very good point on the relative value of castables, fired refractory and rammed mixtures. It has been our observation, in many cases, that there has been a swing from a low-quality, or say, a first-quality fire-brick to a more expensive ramming mix, before all of the possibilities of a better grade of a burned fire-brick have been investigated. Therefore it may be a mistake to assume that because a first-quality fire-brick gives relatively unsatisfactory service, a better quality fire-brick will not do a much superior job.

I think an important advance has been made in castables and in ramming mixes over the past few years, but with castables particularly. One of the most significant advances has been in the development of hydraulic binders specifically for refractory purposes. Prior to the last few years, the binders have all been those which were developed primarily for structural concrete. Because of the improved refractory properties obtained by use of the improved binders, it is apparent that there will be an extended use of castables for higher temperature applications than have been feasible in the past.

**R. Eaton:** I would like to ask Mr. Deegan what did you find to be the best rammed material on the rammed doors and how much better was it than say silica-brick or fire-clay brick-lined doors?

The other question is for Mr. Fayles. In this rammed fantail construction, what refractory did you use, and how thick was that?

**James Kniveton:** We have had a little experience with castable materials, but there is one question I would like to ask: What precautions have you used in the curing of these refractories, the castables or the rammed materials, before they can be put to use?

**H. W. Potter:** I would like to ask Mr. Deegan if he has had any experience with the placement of chrome ore with a cement gun or a BRI gun, and what variables have to be considered in such application in open hearth service to control adhesion.

**Harry C. Paxon:** I would like to ask what type of suspension that they are using for their castables or their plastics, and whether or not they have given any thought to trying to standardize on any particular method?

**M. Reese:** I would like to ask Mr. Deegan if up in Steelton they have tried the rammables on the nose of your bifurcated spouts for your open hearths and I would also like to ask if anyone has done anything on pre-stressed reinforcing on their castables, perhaps in the nature of a prestressed reinforcing cable for arch work, instead of going to a flat roof.

**J. E. Deegan:** The area of the pipe burnout is the area which shows red during operation, and we know that many days before we do the job. So we more or less pre-fabricate a section of ¼-in. plate to the 36-in. pipe. Then we burn the outside plate out, knock out the remaining brick-work around the hole, draw the new plate into place and ram it full of low-grade rammable. It does not matter what brand it is. We give the specifications we want the material to meet and they ship it. We leave the old plate inside, in order to protect the rammed material against shock or any other shock. We have never had any trouble with these plates causing any trouble later on.

In regard to the spouts, the spout I mentioned was not at our plant, but at one of the Bethlehem plants. But there the same thing applies, 220 heats from the single spout, not a bifurcated spout. Any good rammable, chrome or refractory mixture, it does not matter who makes it, so long as it meets the specifications, will do the job. This particular runner of which I spoke has ¾-in. rivets on 9-in. centers; and the bottom of the runner was lined with 4 courses of burned basic chrome magnesite brick. We do not use chrome or other mixtures with a cement or BRI gun. We have done very little suspended work with castables or rammables, but we will in the near future. We hope to get a fantail nosing soon.

We have had only two doors, so far. We are going to go to more, because on the cost basis we have proved they are slightly more economical.

This matter of cost of the silica as against basic rammed doors has been under discussion in our company for the past three or four years, and we still have to prove to Sparrows Point that a rammed door will beat a silica door on the cost basis.

In regard to the spouts, we are still lining them with a common, ordinary ladle brick. We use all pressed ladle brick. They give 16 to 18 heats in the ladles in high carbonized steel. But in the bifurcated runner, if you get more than two heats off the corner in the spout — that is, the corner which takes the rap — you are doing very well, because when the craneman takes the ladle off the platform he does not care how hard he hits the ladle. That is a problem within the plant, which can be straightened out. Lately we have gone as far as five heats on the corner, that is the triangle on the bifurcated spout. Of course, we use a ten-in. stopper-head, ahead of the point that being used to shut off either spout. We do not use the graphite stopper-heads; we use ordinary clay, the same quality as the ladle brick. Any ladle-quality brick, is desirable. Right now we have about three different brands of ladle-brick in our plant, and over a year's time, keeping track of the number of heats, you can hardly tell the difference. We have a tough steel, it is really tough, a high manganese, high carbon steel that taps as high as 2820 F and is held 30 minutes in the ladle before pouring.

**R. Russell Fayles:** Our suspended roof on the side-door heating furnace used about 23 tons of material. It is 9 in. thick. We fire that furnace normally with natural gas. However, in winter months when we are curtailed, as we sometimes are, we fire the furnace with No. 6 oil.

In comments about the use of these rammed and castable materials at intermediate temperatures, it was

felt that they would not stand the severe service in the open hearth fantail. The type that we used in this particular fantail, to answer your question, which was 8 in. thick, is No. 25. The service ceiling for this product is approximately 2850 F. Normally, you do not find fantails failing from temperature. There is water leakage material dropped down through the floor, and a lot of air leakage. All those things tend to make the fantail fail from other than a temperature service condition. In fact, I understand that some of the samples that have come out of fantails that have been in service indicate that 2700 F is never attained at that point in the furnace. Some of the castables are approaching a 3000 F service limit at the present time, and certainly that is ample to cover any temperature you are going to have in the fantail area.

Mr. Reese asked about pre-stressed concrete. We have done nothing with it.

**R. E. Wolfensperger:** What types of suspension have you used?

**Robert R. Fayles:** All you need is something to hold the rammed or castable material in place. To give an illustration, this side door heating furnace was originally the conventional suspended tile roof having two channel members facing each other. The shaped suspension tile were hung on the structure and T-tile hung on these suspended pieces.

What we did was tear out the brick work completely and fasten light I-beams to the steel members at the lower face, properly positioned, so that with the 9 in. of mix, the hot face of the refractory was at the proper elevation.

**Harry C. Paxon:** I was interested in whether or not they were going to adapt any standard means of suspension of their own or were going to take whatever the supplier gave.

**Robert R. Fayles:** We are interested in first eliminating the casting cost, castings cost a lot of money, and I do not think they do much for the suspension.

Second, we want to buy one type tile. We do not care where it comes from, but we want to use the same tile and design on every installation we make. Then we will stock only four sizes: one for the 6 in., one for the 9 in., one for the 13 in. and one for the 15 or 18 in. lining, if we ever get that thick. We will not have to worry about whether it fits or whether it does not fit. That is what we are interested in.

**R. E. Wolfensperger:** Do you not think that will come when the materials are more uniformly accepted?

**Robert R. Fayles:** I do not think that the brick that one company sells us, in design, and so forth, means anything more than the brick we might buy from another company. I do think the design can be standardized.

**William N. Horko:** Regarding pre-stressed concrete, from what I know about this type of construction I do not believe it would be applicable to refractories.

In answer to Mr. Kniveton on how long should castable refractories be seasoned before being put to use, we usually give them 24 hours. Most of our experience has been with door linings. These are usually made up two or three weeks previous to the time of use and therefore have plenty of time to season.

**R. E. Wolfensperger:** If you put a cast door on a hot furnace without a lot of drying, at a fairly high temperature, it is liable to explode in a series of small pops and pieces pop off of the face of the material. That is, the dehydration of these hydraulic setting compounds will cause moisture to be liberated very fast, and form steam pockets, you may get spalling of the door, if not complete disintegration.

Someone asked about the use of the BRI or cement gun. We have used it in dressing up straight vertical sections in the back wall of the furnace which does not have a full sloping back wall. That is the only place we have used that, particularly where you have a thick back wall, and might have to shut down a couple of heats for repairs. You can put some chrome material on the back wall while the furnace is still hot, and if you can get the stuff to stick, you will delay shutting down the furnace for repairs.

**J. E. Deegan:** Is the BRI gun a pressure vessel?

**Robert R. Fayles:** The use of the BRI gun or any other pressure vessel is not illegal in the State. However, it must be manufactured to meet the State code, or the code on pressure vessels.

**J. E. Deegan:** The reason I raised the question is that a boiler inspector in the State of Pennsylvania mentioned to me that this gun was out. Perhaps since that time they have corrected it for use in Pennsylvania. I know we can use it at our Lackawanna plant and always could, because the code in the State of New York was not as severe as in Pennsylvania.

**Robert R. Fayles:** If you want to order a gun, you put on the order that it has to conform to the State code. The unit is then made to conform to the State coding.


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# ENGINEERED PROTECTIVE GROUNDING FOR STEEL PLANTS

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*. . . . plant grounding systems should be engineered to give maximum protection with economy . . . . many factors must be taken into account . . . .*

▲ A well co-ordinated and executed safety program is one of the major factors in good employee relationship in an industrial organization. It is the responsibility of the factory management to provide safe working conditions for operating personnel, and it is the duty of the supervising staff to see that the safe conditions are maintained all the time.

In a centralized steel plant, electricity is so widespread that no operation is without electrical equipment. Working conditions in a steel plant are such that it becomes essential to see that the electrical apparatus is free from danger and is maintained in that condition.

Electric shock is therefore an ever present danger in a steel plant where men work near electrical equipment, unless safety precautions are taken to enclose all the current carrying parts in metallic casings, and steps taken to quickly isolate the equipment, if the metallic casings accidently are charged with electricity due to faults in the apparatus.

In modern countries, there are governmental regulations compulsorily enforced in connection with installation and operation of electrical equipment and the grounding of the apparatus to make it safe against possible dangers of electric shocks. There is, however, still a great difference of opinion prevailing amongst electrical engineers on the method and effectiveness of grounding as a safety measure. Grounding in many cases is carried out in a manner depending on the whims of the person in charge of the installation; thus though money and energy are spent to a great extent, many systems may be found to be fundamentally defective and often dangerous.

Engineered grounding installations are therefore an essential part of an electrical system, and an attempt is made in this paper to discuss the principles of providing safety grounding installation in a steel factory.

## SHOCK VOLTAGE

When an electrical apparatus develops a body fault i.e., if one of live lines comes into direct contact with the apparatus casings, the frame of the apparatus takes up a certain voltage above earth. If a person touches an apparatus, he takes over the voltage in his body. The magnitude depends on whether the neutral of the electrical supply network is grounded or otherwise. The magnitude of the voltage shunted over the human body also depends on the nature of the surface on which the man stands, i.e. on the resistance between the man's feet and ground. It is effective voltage that is shunted by the person over his body that is called "shock voltage." It is the shock voltage that determines the seriousness of the electric fault. The shock voltage is therefore the voltage drop between the hands touching the faulty apparatus and the ground on which the man stands. It does depend appreciably on the resistance between the human feet and ground. If the latter resistance is high the shock voltage is low. The lower the "foot to ground" resistance, the nearer does the shock voltage approach the full ground fault voltage of the electric system, the limiting value being line to neutral voltage of the system.

## ELECTRIC CURRENT AND HUMAN BODY

As early as 1897, Prof. H. F. Weber had carried out experiments on himself to determine the current bearable by a human body and the magnitude of the voltage which becomes dangerous. In recent years, Dalziel and Langen have published several papers on their experiments of electric current on various individuals. From the study of the available literature, the following observations can be deduced.

At 50 and 60 cycles, current about one milliampere is just perceptible, when electrodes are held in both hands. There is a tingling sensation first, which increases in intensity as the current is increased, at the same time involuntary muscular contractions appear. Between 15 and 20 milliamperes, muscular contractions are severe and painful. At 20 milliamperes or more breathing becomes somewhat difficult. Current in excess of 20 milliamperes may cause involuntary cessation of breathing due to temporary paralysis of the nerve centers and respiratory system. Current of the order of 100 milliamperes for 3 seconds or longer, cause ventricular fibrillation which results in death.

The bearable direct current voltage is about 3 times the alternating current at power frequencies. Above 100 cycles there is only heating. From the data on electrical fatalities published in recent years, it appears that the victims were revived in 60 per cent of the electrical accidents at less than 40 kv, and in about 90 per cent of the cases above that figure. This indicates that danger does not necessarily increase with voltage, either because the greater muscular reaction tends to throw the person clear of the live conductors or else ventricular fibrillation does not occur with currents above 250 milliamperes.

From tabulated results of brief exposure to a-c potential, it appears, with very low body resistance of about 1000 ohms, death accompanied by slight burns may be regarded as certain with 100 volts; while at 1000 volts death is probable with marked burns; while at 10,000 volts survival with severe burns may be expected. With a body resistance of 10,000 ohms only painful shocks will be experienced at 100 volts, certain death at 1000 volts and probable death with severe burns at 10,000 volts. Body resistance of about 100,000 ohms with bad contacts would make 100 volts practically harmless, 1000 volts shocks merely painful and 10,000 volts fatal.

Electrical resistance of the human body depends on several factors as contact area, moistness of the skin, duration of current flow and the magnitude of current. With the increase in current flow, resistance is found to decrease perhaps due to heating. Available data indicates that 30 milliamperes passing, the body resistance with moist skin in a particular case was 1670 ohms. Between 50 and 100 milliamperes with moist skin, the resistance may drop to about 1300 ohms. Body resistance with one ampere current is found to go down to 500 ohms or less.

It has been found that with an average individual, the maximum current at which muscular control is still possible is a little less than 22 milliamperes. With moist skin it is observed that 40 volt is just the maximum permissible shock voltage for the limit of 22 milliamperes. Safety grounding installations should therefore be so designed that the maximum shock voltage is limited to 40 volts.

## SYSTEM GROUNDING

Electricity regulations for securing the safety of the public specify that a point on every system at low voltage exceeding 125 volts shall be connected to ground. The object of system grounding is to prevent, in case of a ground fault, the voltage to ground rising above a certain value. Another important purpose is to limit the danger in case high voltage of the system through some fault creeps over to the low voltage side of the system.

System grounding is carried out by grounding the neutral either directly or over an ohmic resistance. In systems with ungrounded neutral, the small leakage currents may give rise to high shock voltages in case an isolated ground fault persists somewhere on the system. The healthy phase would then take up a higher voltage to ground. It is therefore always advisable to ground the neutral of a system in the interest of safety.

## NEUTRAL GROUND RESISTANCE

Resistance of a neutral grounding station is to be considered from two distinct aspects, viz:

1. Considering creepage of high voltage to low voltage side.
2. Considering the occurrence of a ground fault on low voltage side.
3. *Creeping of high voltage on to low voltage side*: The nature of the high tension system is to be considered, i.e., whether the system is ungrounded, compensatively grounded or grounded over resistance. In case of ungrounded system, the earth fault current is the capacitive current of the lines. In case of compensated grounded systems, the capacitive earth fault currents are compensated until a small residual current remains as the fault current. In systems grounded over ohmic resistances, every earth fault is a single phase short circuit, the fault current depending on the total earth resistance.

   If the high tension creeps over to the low tension side due to insulation leakage or a flash-over, the fault current flows over the secondary, on to the grounding station to ground. Thus the neutral ground carries the high tension fault current. In that case, the voltage drop over the neutral ground station will be $I_o R_o$ where $I_o$ = fault current and $R_o$ = neutral ground resistance. If the maximum voltage allowed at the grounding station is limited to 125 volts, the neutral ground resistance should then not exceed:

$$R_o = \frac{125V}{I_o}$$

If the fault current of the high tension network is then known, the ground resistance value can be easily ascertained.

High tension equipment is generally protected by earth leakage relays. Suppose the earth leakage relay is set for 30 per cent of the full load current which is 100 amp, i.e., the relay operates for 30-amp earth fault current, the neutral ground resistance then would be:

$$R_o = \frac{125V}{30A} = 4.16 \text{ ohm}$$

From the point of protection against creepage of high tension on to the low tension side, a station ground resistance of 4 ohms will be just sufficient,

if the earth leakage current is relayed at 30 amp.

4. *Occurrence of ground fault on the low voltage side*: In case of a 3 phase system, when one of the lines develops ground fault, the voltage to earth of the healthy lines goes up, with the result that the neutral assumes a voltage above earth.

   In case of a solidly grounded neutral, the ground resistance should be so selected that the healthy phases do not assume voltage above earth beyond a certain value, say 276 v; i.e. the neutral assumes a voltage above earth of about 40 volts, in case of 440-v, 3-phase system.

   If $V_o$ is the neutral potential above earth and $I_o$ max is the fusing current of the fuse, the earth resistance will be:

$$R_o = \frac{V_o}{I_o \text{ max}} = \frac{40 \text{ V}}{I_o \text{ max}}$$

## HIGH TENSION EQUIPMENT GROUND AND LOW TENSION NEUTRAL GROUND

Generally in a sub-station both high and low tension equipment is located in the same place. A transformer has naturally both the voltages together. The problem thus arises whether it is good to take both high tension and low tension to the same point, i.e. should the high and low tension groundings be common. If separation on technical grounds is necessary, the minimum distance between the two grounding stations is recommended to be about 60 feet. Economically however this may become prohibitive. The grounding and bonding should be so made that the fault currents due to high tension faults flow straight towards the high tension power neutral without passing over the low tension neutral grounding station. In that case, the high tension equipment and the low tension neutral ground can be made common.

In cable network, it is advisable to interconnect the sheaths of each cable, cable end boxes, high tension switchgear, etc., and connect them to a common ground. In a substation this is the most convenient method. The object of the common ground is to absorb any stray ground currents which would otherwise attack lead sheaths of cables. The earth fault current on the high tension side, however, goes over the cable armoring and lead sheaths and the grounding station is actually relieved of it.

The occurrence of high voltage on the low voltage side of a transformer through the grounding system depends on two factors, viz:

1. The product of the earth fault current and the impedance of high voltage grounding station.
2. Position of low voltage neutral grounding station with respect to the high voltage neutral grounding station.

If the low voltage ground is within the voltage gradient of the high voltage ground, the former will then take up certain voltage depending on its position. To prevent this being a dangerous value, there are three possibilities, either to increase the separation, or to reduce the value of earth fault current, or to prevent the fault current from flowing over the high tension grounding station. The solution is different depending on the system conditions. If the chances are that due to ground faults on the high tension side, ground voltages take up high values which are maintained for a considerable period, it is dangerous to allow the two grounds to be common.

## GROUND ELECTRODES INSTALLATIONS

To be satisfactory, ground electrodes of an earthing station should comply with the following requirements:

1. To operate the protective gear under fault conditions it should have a sufficiently low resistance at all times of the year to permit sufficient current.
2. It must have adequate current capacity so as to carry the fault current without excessive increase in the ground resistance for a time sufficient to operate the protective gear.
3. Voltage gradient on the surface of the ground around the electrode should not be dangerously steep.
4. Electrode materials and connections should have a high resistance to soil and atmospheric corrosion.
5. For certain cases, the electrodes must have sufficiently low surge impedance to prevent a flash over from earthed metal work to insulated conductor where a lightning surge takes place.

## HIGH VOLTAGE NEUTRAL GROUNDING STATIONS

The provision of a satisfactory ground, for the neutral of a solidly grounded system requires careful consideration. Knowledge of the system characteristics, the characteristics of the protective relays, and the soil conditions at site are essential features which require study. If the relay system is set for instantaneous tripping, the main characteristics of the ground is the maintenance of low resistance. This means that the grounding station need not necessarily be near the substation, but should be provided at a suitable site, having lowest soil resistivity. Where inverse-time relaying system is provided, the time for the relay should be such that at a given fault current, the tripping time is less than the life of the electrode at the same current. It is necessary to take into account the specific loading of the electrode, its behavior on short time overloads. Where the current is of the order of thousands of amperes, a considerable area is required for dissipating the heat energy without causing failure of the electrode. This can only be provided by a generous use of driven rods, or by use of plates, strips or conductors in parallel with rods.

Whatever the use of the earth electrodes may be, the following must be given proper consideration for complete reliability.

1. Length of time the electrode is expected to remain in a satisfactory and reliable condition. If a long life, without much inspection and testing is to be expected, it is necessary to spend additional money to secure a durable electrode.
2. The nature of soil resistivity, whether the resistivity increases or decreases with depth. If the former is the case, shallow electrodes are prefer-

able; if the latter condition applies, deeper electrode is the solution.

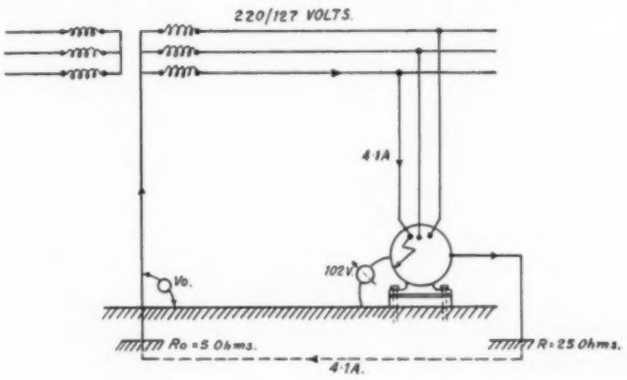
3. Necessity of providing artificial treatment of the electrode with coke or with salt.
4. In soil of high resistivity, consideration of other methods of grounding from point of view of cheapness and effectiveness.
5. Consideration of installing the earth electrodes at a suitable site, by carrying an earth wire, if the soil resistivity at the selected site is high.
6. Expenditure to be incurred on grounding and other protective devices, to give insurance against accidents through electric shocks. This depends on the extent of the system, as for smaller systems, the cost per unit will be high, giving a lower profit for a given degree of safety.
7. In all grounding installations, care must be taken to ensure permanent and efficient manner of electrode installations, and other ground connections, as it is the most likely part of the system to be ignored for years, once it is installed. According to soil corrosion studies of the Bureau of Standards over a period of 8 to 12 years, the rate of corrosion of wrought iron and mild steel in soil is 15 times that of copper. There is thus a definite advantage in using copper or copper sheathed steel rods for grounding. This avoids the contacts of dissimilar metals at the connections and practically eliminates atmospheric corrosion.

## PRACTICAL METHODS OF PROVIDING PROTECTIVE GROUNDING INSTALLATIONS

1. *Individual protective grounding*:

Figure 1 gives the method of individual protective grounding installation. The neutral of the system is grounded, and the metal casing of each apparatus is connected over a copper wire to ground. Each ground fault in an apparatus develops into a single phase short circuit, the fault current flowing over the faulty phase, over the fault spot, over both the grounding electrodes, back to the power source. The magnitude of the fault current depends on the total resistance in the fault circuit. For values given in the diagram, the fault current is about 4.1 amp. The voltage of the faulty motor body to ground is 102 volt. The motor thus takes up a dangerously high voltage, though it is grounded. The problem thus resolves into the earth resistance values whatever the method of protective grounding adopted.

**Figure 1 — Diagram shows method of individual protective grounding. The magnitude of current and shock voltage are indicated for a particular condition.**




If the resistance of the outer conductor is neglected, as it is generally very small compared to earthing resistances, the voltage drops are distributed over the earth resistances, R and $R_o$; the fault current will therefore be given by the equation:

$$I_o = \frac{V_e}{R_o + R}$$ where $V_e$ is the phase voltage.

If the neutral resistance $R_o$ is fixed, the value of the protective individual earthing R will be:

$$R = \frac{V_e}{I_o} - R_o$$

The value of $R_o$ has a maximum limiting magnitude, if 40 volts shown is the permissible shock voltage, given by the equation:

$$R_o = \frac{40V}{I_{o\ max}}$$ where $I_{o\ max}$ is the fusing current of the largest fuse.

$$\text{Therefore } R = \frac{V_e}{I_o} - \frac{40}{I_{o\ max}}$$

If $V_e = 254$ volts for a 440-v, 3-phase system

$$R = \frac{254}{I_o} - \frac{40}{I_{o\ max}}$$

Taking worst conditions, where $I_o = I_{o\ max}$

$$R = \frac{214}{I_o}$$

If the total impedance of the circuit is taken into consideration, the value of R will become still less.

If 30 per cent impedance is taken, the value of earthing resistance will be:

$$R = \frac{149}{I_o}$$

It will be seen that the shock voltage in such a system of earthing always tends to go beyond the permissible maximum. The earthing is effective only when the fuse is so selected that its fusing value is always below the fault current so that disconnection is effected within a short period. It is therefore to be noted that the main formula:

$$R = \frac{40}{I_{o\ max}}$$

gives always the lowest value and therefore the safest value, even though the magnitude of the earth resistance varies from period to period.

2. *Multiple protective grounding*:

The individual grounding system becomes very costly as the number of consumers increases, and often becomes prohibitive. The multiple grounding therefore solves the problem to a great extent. This is a mixture of system and apparatus grounding, the non-current

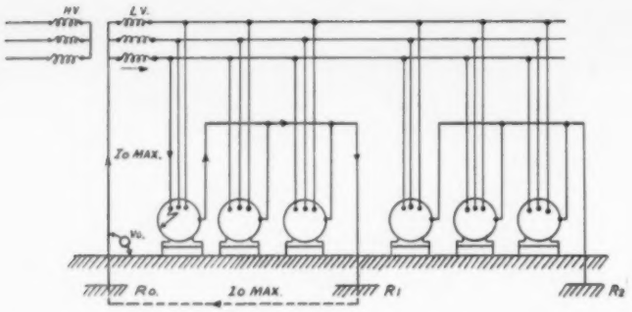



**Figure 2 — Diagram shows the method of multiple protective grounding, where grounding is carried out in groups. Ground resistance values should be suitable for the largest fuse in the circuit.**

carrying metal work of each apparatus is connected to a common wire, which is connected to ground at one or more places. It is necessary to carry a common ground wire, to which each apparatus frame is connected. The arrangement is shown in Figure 2.

Study of Figure 2 shows that instead of individual grounding, the group grounding is adopted in which one set of grounding stations serves a group of apparatus of varying capacities. The cross-section of the common earth wire should be suitable for the largest apparatus and the ground resistance should be such that the highest fuse in the circuit will blow within a short period, if the fault occurs on it.

Another great disadvantage of the system lies in the fact that if a fault somewhere on the system is not removed, the dangerous shock voltage is carried over to all the interconnected apparatus due to the common ground wire.

The magnitude of the earth resistance can be measured in the same way as in (1), however, the operating current $I_{o\ max}$ should be such that the largest fuse will blow off quickly.

## LIMITATIONS OF PROTECTIVE GROUNDING SYSTEMS

In order that the grounding fulfils the regulations, i.e., the shock voltage remains within specified maximum value, the value of earth resistance should be proportionately smaller, the higher the fusing current. It is very difficult to get even reasonably low values of earth resistance in most soils unless an underground metallic water pipe line system is available throughout.

Protective grounding therefore becomes very expensive and uneconomical. Moreover it can safely be practised for very small consumers or apparatus protected by small capacity fuses. If the shock voltage is not to exceed 40 volts and the earth resistance is to be within one ohm, the maximum earth fault current allowable is 40 amp. Therefore only 40-amp earth fault current can be permitted with normal grounding. If the equipment is protected by a 400-amp fuse, the grounding resistance has to be 0.1 ohm. Moreover the grounding electrodes take part in the earth faults, as the full fault current flows over them. The capacity of the earth electrodes, heating effects due to heavy currents and weather conditions together introduce uncertainties and difficulties. The most effective location for the protective grounding system is therefore the interconnected underground water system using metallic pipes.

The dangers of the multiple protective grounding system as is generally practised in most factories can be easily appreciated, if the grounding stations are not maintained to very low constant values. This system is therefore not the most suitable safety grounding system, though much labor and money are spent on the large number of grounding stations that are necessary for the purpose.

3. *Neutralizing method of protective grounding*:

If it is possible to relieve the grounding stations to a great extent of the earth currents, i.e., if the grounding stations are not allowed to carry the fault current, it is possible to reduce the number and size of grounding stations. The resistance values can be kept within economical limits and at the same time provide maximum protection.

Method of neutralizing, i.e., connecting each apparatus to a common ground wire, taken out from the system neutral and grounding that neutral wire to ground at one or more places, is a very convenient practice.

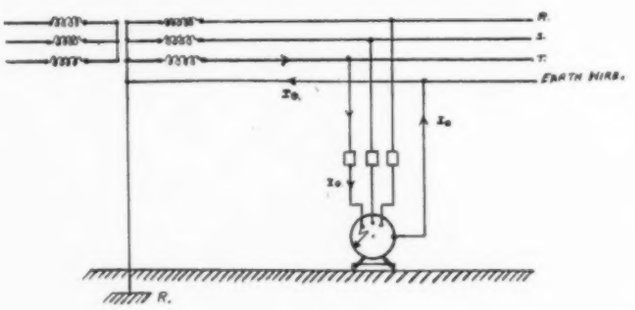
Figure 3 gives a simple method of neutralizing. If the apparatus develops a body fault, the fault current flows from the faulty phase over the fault spot to the neutral ground wire, back to the neutral of the power source; it is thus a single phase short circuit over the neutral wire. The fault current can be easily controlled and the fault quickly isolated. The grounding station does not take any part in the fault current.

The neutralizing can therefore be considered as the most suitable method of earthing according to regulations.

However, under certain conditions, the neutralizing method can generate other dangers of high shock voltages, which would not have otherwise arisen. There are three fundamental conditions of neutralizing, which should be specifically fulfilled.

a. *Ground fault in line* — The first condition of neutralizing to be fulfilled is when one of the line conductors, apart from the apparatus body fault, gets a ground fault. In case of such fault, in order that the shock voltage remains within the prescribed value, the system neutral grounding resistance should have a definite minimum value as shown in Figure 4, because the shock voltage overlaps all the interconnected equipments and spreads all over the grounding installations. Re-

**Figure 3 — Diagram shows method of neutralizing practice in safety grounding installation. The grounding station is relieved of the fault current.**



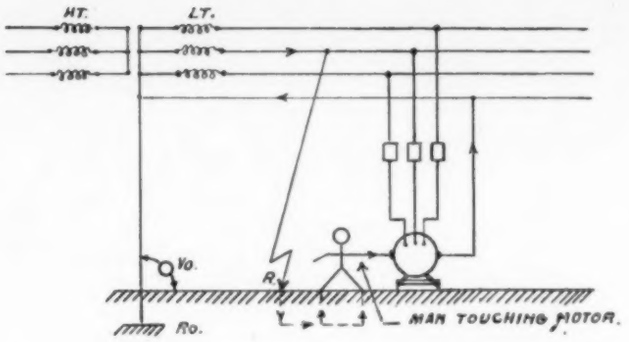



**Figure 4 — Diagram shows effect of neutralizing when one of the lines develops a ground fault. The neutral wire under certain conditions attains a high shock voltage.**

ferring to Figure 4, the value of the ground electrode resistance is given by the equation:

$$R_o = \frac{V_o R}{V_e - V_o}$$

where $V_o$ is to be taken as 40 volts and R is the earth fault resistance. It is observed that such faults rarely occur over more than 5 ohms resistance. Therefore if R = 5 ohms,

$$R_o = \frac{40}{254\text{-}40} \times 5 = 0.94 \text{ ohm}$$

The first condition for neutralizing therefore is that the system neutral grounding resistance shall never exceed 1.0 ohm.

b. *Single phase short circuit* — The second condition of neutralizing is that when an outer conductor makes live contact with the neutral ground wire, the resulting short circuit current should be able to blow off the fuses immediately preceding the fault. In order to ensure this, the neutral conductor should have a fixed cross-section area compared to the main conductor. If the neutral conductor has a conductivity of at least 50 per cent of that of the main outer conductors, this condition of neutralizing is easily fulfilled.

c. *Breakage of the neutral ground conductor* — The third condition of neutralizing is that the neutral wire should be laid carefully so as to avoid its breakage. The effects of breakage in the neutral wire are different, depending on the layout, i.e., whether it is laid above or below the main lines, position and frequency of groundings along the route, position of the fault with respect to the break, etc. In order to reduce the danger due to breakage, the following points should be observed:
   A. Neutral wire in overhead lines should be laid below the live main lines.
   B. Load should be distributed as uniformly on all the 3 phases, as possible.
   C. Neutral wire should be grounded in the beginning and also at the end of the lines.
   D. Careful layout so that the breaking of the wire is minimized.

The three fundamental conditions of neutralizing are therefore as follows:

1. The neutral earth wire should be earthed at the substation and at the end of the line in case of overhead systems. The earth resistance should not exceed one ohm.
2. In case of a short circuit between the earth wire and a live wire, the fault current should be of such a magnitude as to blow the fuses within a short period.
3. The neutral earth wire should be laid with as much care as main wires. In case of portable single phase equipment, the current carrying neutral wire should not at the same time be used as earth wire.

## PROTECTIVE GROUNDING AND NEUTRALIZING COMBINED

The question now arises, whether it is advisable to use both the neutralizing and the protective earthing in the same system at the same time.

Assume that the neutralizing practice is followed, and that it becomes necessary to ground a single isolated apparatus or section situated at a distance. The common neutral for grounding is not drawn. Water pipe line is used as earth electrode.

Under the above conditions, if a ground fault occurs in the isolated equipment, the neutral ground wire will take up a voltage; the magnitude of the voltage will be higher, the lower the resistance of the isolated section grounding. This can be easily explained, because the protective grounding of one apparatus cancels the neutralizing system of all the rest. The method of protection then becomes similar to multiple protective grounding.

It should therefore not be permissible to use protective individual grounding in a system where neutralizing is practised, without taking a common earth wire.

The neutralizing system therefore demands that all the conditions for the purpose must be fulfilled, in order that the system becomes quite safe. Due to the inherent possible dangers, many engineers do not like the neutralizing system to be introduced and utilize protective earthing along with various other precautions.

## GROUNDING PRACTICE IN A STEEL PLANT

The question now arises as to the most suitable practice of grounding that could be introduced in a large factory as in steel works, which could satisfy all the safety regulations and at the same time be convenient and simple.

The points to be decided before grounding installations are carried out are:

1. Should the supply neutral i.e., transformer neutral be grounded at the substations?
2. Is the protective grounding, either individual grounding, or multiple grounding the best method?
3. How are the neutralizing conditions fulfilled, if neutralizing is practised? Is it necessary to take separate copper earth wires for neutralizing?
4. How many separate earthing stations are necessary in a single factory building or unit, supplied by the same set of transformers?

In several factories, the secondary of power transformers has an ungrounded neutral i.e., the secondary

440-v, 3-phase supply is an insulated neutral supply. The method of grounding motor frames is as shown in Figure 5.

The method has the following basis:

a. Motors and apparatus are taken in groups. Ground wires are drawn separately along the whole group and each machine is connected to the common earth wires which are then connected to grounding stations and the steel structures.

b. A single earth fault in any one machine of a particular group has no effect, as no current can flow over the grounding station because the system neutral is ungrounded. The fault therefore remains hanging on the system. The voltage balance of the system against ground is disturbed, the healthy phases taking higher voltages to ground than the phase voltage.

c. If another machine of the same group develops a ground fault on some other phase, the faults then combine into a double ground fault, causing a phase to phase short circuit. The fault current will then be so high that the protecting fuses of the smaller machine will blow off and isolate the fault. It is also probable that both the faulty machine fuses will blow off and indicate both the faults. The grounding station takes no part at all.

d. If the second earth fault develops in a machine of another group, then the fault current will flow over the grounding stations of both the groups. The magnitude of the fault current then depends on the grounding resistances of both the stations. The fault will be isolated only if the ground resistances are of very low values, sufficient for the fusing capacity of the largest machine in each group.

The system in fact is a multiple grounding system with isolated neutral supply. Its advantage lies in the fact that service interruptions are few because a single phase earth fault has no effect. This method however demands very good phase insulation of lines throughout, as even small leakage currents generate high shock voltages all over the group in which ground fault has developed. The earthing resistances of the group grounding stations must be very low i.e., less than 0.1 ohm, for 400 amp, normal current machines.

The above system has many disadvantages and has inherent dangers against safety. *However if no untoward effect is felt, it is only because the mill structure is a common one and serves the purpose of a neutral earth conductor.*

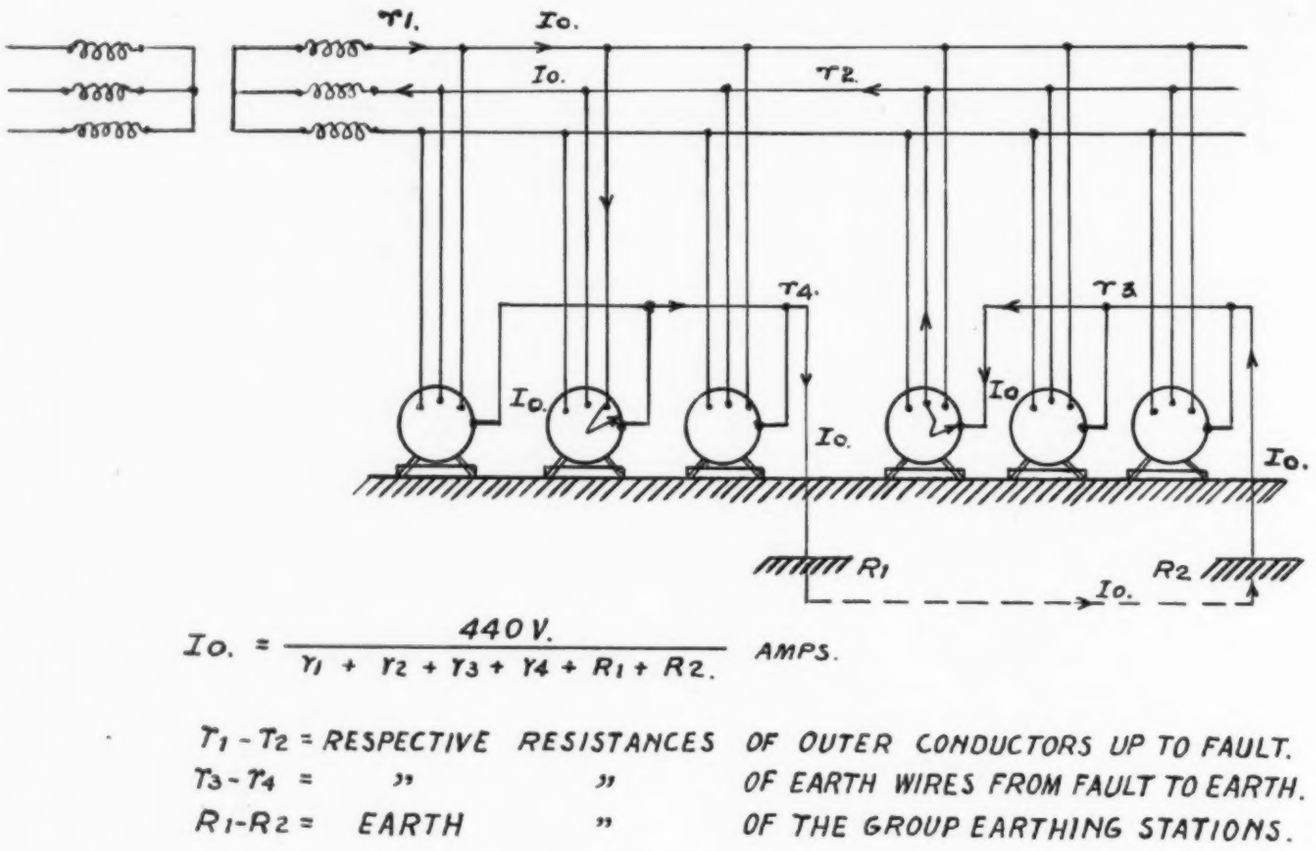



**Figure 5 — Diagram shows method of multiple protective grounding with ungrounded neutral system. Protection is effective only when two ground faults simultaneously occur in two different phases.**

## MULTIPLE PROTECTIVE EARTHING WITH EARTHED NEUTRAL SUPPLY

In order to eliminate the inherent dangers caused by small unavoidable leakage currents in an extended net-

work of a plant, it is necessary to have the neutral of the supply transformer grounded solidly (Figure 2).

The method of grounding then becomes the same as in Figure 5, however, with neutral grounded. In this case, every single ground fault becomes a single phase short circuit, the fault current flowing over the group grounding station and the main neutral ground. For bigger machines, therefore, the grounding stations must have low values. Invariably, the shock voltages will be high, as it will be very difficult to maintain the earthing stations at those low values except when connected to a continuous underground metallic water pipe system.

## NEUTRALIZING SYSTEM OF EARTHING PROTECTION

The method of neutralizing is the most effective, provided of course that the three neutralizing fundamental conditions are fulfilled.

Those conditions are of course difficult of fulfillment in case of overhead outdoor distribution. However in a factory those conditions can be easily fulfilled.

The building structure forms a very good ground conductor, whose effective section will be several times that of a copper conductor normally used. The resistance will be practically negligible.

The grounding can be carried out as follows:

1. Connect each motor and switch etc., by means of a separate copper earth wire of proper section and take it to the building column, where it can be socketed and bolted to the column or welded with it.
2. The building structure forms a common neutral earth conductor for all the equipment in the plant.
3. If the buildings are separate, supplied from the same source, connect both the structures by copper wires, flats, cable sheath or armoring.
4. Select good grounding sites round the factory building structure and ground the structure to properly made grounding stations.
5. Bring out the transformer neutral and connect it to one of the grounding stations. One grounding station should preferably be near the substation.

The above practice does away with the necessity of taking separate common earth bus wires, with all the consequent disadvantages. No joints are necessary, the danger of breakage is eliminated; and any earth fault anywhere is at once eliminated because it at once converts itself into a single phase short circuit, which would give rise to heavy fault currents.

All the three fundamental conditions of neutralizing are completely fulfilled. Every type of fault necessarily develops into a heavy single phase short circuit, which will make itself felt within a few seconds.

## NUMBER OF EARTHING STATIONS NECESSARY

The main object of increasing the number of grounding stations is to reduce the grounding resistance. From the consideration of the shock voltage gradient, only two similar grounding stations at the two ends of a line will be sufficient. Increasing the number does not improve the shock voltage magnitude in any way, except that the gradient is changed. With the neutralizing system of grounding, the value of grounding resistance need not be very low, as the grounds do not play any part in fault current. They simply maintain the building structure to earth's potential.

For the sake of fullest safety to comply with regulation, three earthing stations selected at suitable locations, each having 3 ohms resistance should be quite sufficient. (Here it should be considered that the building has also its ground resistance which may also be quite low for most of the structures.)

## CONCLUSIONS

Government electrical inspectors naturally lay maximum stress on grounding of electrical installations according to prevailing regulations. The plant engineers therefore try to do their best to meet with the requirements of government inspectors.

It is the object of this paper to try to rationalize the grounding practices in large plants.

In deciding the effectiveness of a particular method of grounding, a thorough analysis should be made of the conditions prevailing whether:

1. The method of grounding that is actually followed is really safe, and fulfills the requirements as per regulations.
2. If in trying to meet the regulations, grounding is not being overdone, demanding a lot of labor, materials, time and causing a lot of friction amongst the operating sections involved.
3. How far the grounding precautions are necessary under varying conditions of installations and operation.
4. How the main grounding stations should be distributed and what minimum resistance values are enough.
5. The distribution layout is so designed that the fuses or the overload switches are just enough to isolate the earth fault and remove it within a short time, or if the fault persists, the shock voltage remains below the dangerous value.

To get the best idea of grounding conditions in a plant, the following data should be a great guide if taken in each case during erection:

1. Total resistance of the whole building structure, by voltmeter and ammeter method.
2. Total earth resistance of the building by means of an earth tester, or any other method.
3. Approximate magnitude of shock voltages that could be generated at the site of the working machine.
4. The single phase short-circuit current that a particular transformer installation will give, as compared with the largest capacity machine installed and the protective switches used. This will be necessary as a guide in case of a main roof-truss line making a live contact with a section of the building structure.

# *Design and Operation*
# OF ELECTRIC WELD PIPE MILL
# *at National Tube's National Works*

By G. C. ANDERSON
Superintendent, Electric Weld Mill*
National Tube Div.
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***. . . . one of the most modern electric weld pipe mills is that described in this paper . . . .***

▲ IN 1930, the National Tube Co. installed at its Christy Park Works a mill for the manufacture of large diameter electric fusion welded pipe from flat skelp. The process incorporated a planer and presses for forming the cans, 30 welders for welding the seams, and pyramid rolls for rounding up the finished product.

The welding was accomplished at the rate of 12 to 18 in. per min, welding from the outside onto a back-up shoe, with a single arc. A submerged arc process which was developed by the National Tube Co. was employed.

The mill ceased operation in 1932, after having made approximately 500 miles of pipe and remained idle until 1940 when it was torn out to make room for war production. During the period of operation of this mill, the National Tube Co. licensed the process and sold some equipment to the Western Pipe and Steel Co. of California and assisted in the starting of their mill.

In March 1950, when the National Tube Co. reentered the electric fusion welded pipe business, a number of pieces of the equipment for the mill were obtained from a corporation subsidiary — The Consolidated Western Steel Corp. — of which the Old Western Pipe and Steel Co. is a part.

National Tube Co.'s fusion weld mill was built to meet the eastern demand for large diameter, high strength pipe for the transmission of natural gas under high pressures. Most of the contracts for pipe specify minimum yield strengths of 52,000 psi and maximum ultimate strengths of 72,000 psi. Also specified is a minimum elongation of 22 per cent in two in. in the plate. No elongation requirement is normally entered for the weld section which is naturally somewhat less ductile, although elongations of approximately 15 per cent are common.

Also specified is the chemical composition of the plate to be used. Although composition requirements vary with various orders, the following percentage ranges are typical:

| | |
|---|---|
| Carbon | 0.20-0.34 |
| Manganese | 0.85-1.29 |
| Phosphorus | 0.055 max |
| Sulphur | 0.06 max |

Such plate in the as-rolled condition has a yield point in the range of 44,000 to 54,000 psi and an ultimate strength of 80,000 to 85,000 psi.

The plate for the National mill is obtained from the 100-in. mill of the United States Steel Co. at Homestead, Pa. The plate is ordered to standard commercial tolerances of length, width and thickness. The edges are circular sheared and the ends guillotined. Plate samples from each heat are taken to evaluate plate properties and chemical composition in advance of shipment by the mill.

The mechanical properties required by contract are obtained by cold working the welded pipe in an hydraulic expander. Thus when making 30-in. outside diam 0.312-wall pipe, the forming and welding equipment are producing a tube smaller than the finished pipe by the amount of the expansion which, for the composition indicated, amounts to approximately 1.5 per cent of the circumference.

Although most of the plants making fusion welded pipe were making 30 to 32 ft lengths, the limitation being the rigidity of the pyramid rolls for the smaller sizes, it was decided that National would make 40 ft lengths and that press forming of the skelp would be employed.

Figure 1 shows the layout of the mill in bays 7, 8, 9 and 10 of the main pipe mill building at National Works. This area was formerly occupied by butt weld mills which had been moved to Lorain, Ohio. This area, containing approximately 125,000 sq ft, houses all the operations from receipt of the plate to the loading of the finished product.

Although the area is sizeable enough for regular production, it is somewhat small for emergency situations, such as stocking material between operations to permit

*At time of paper presentation.

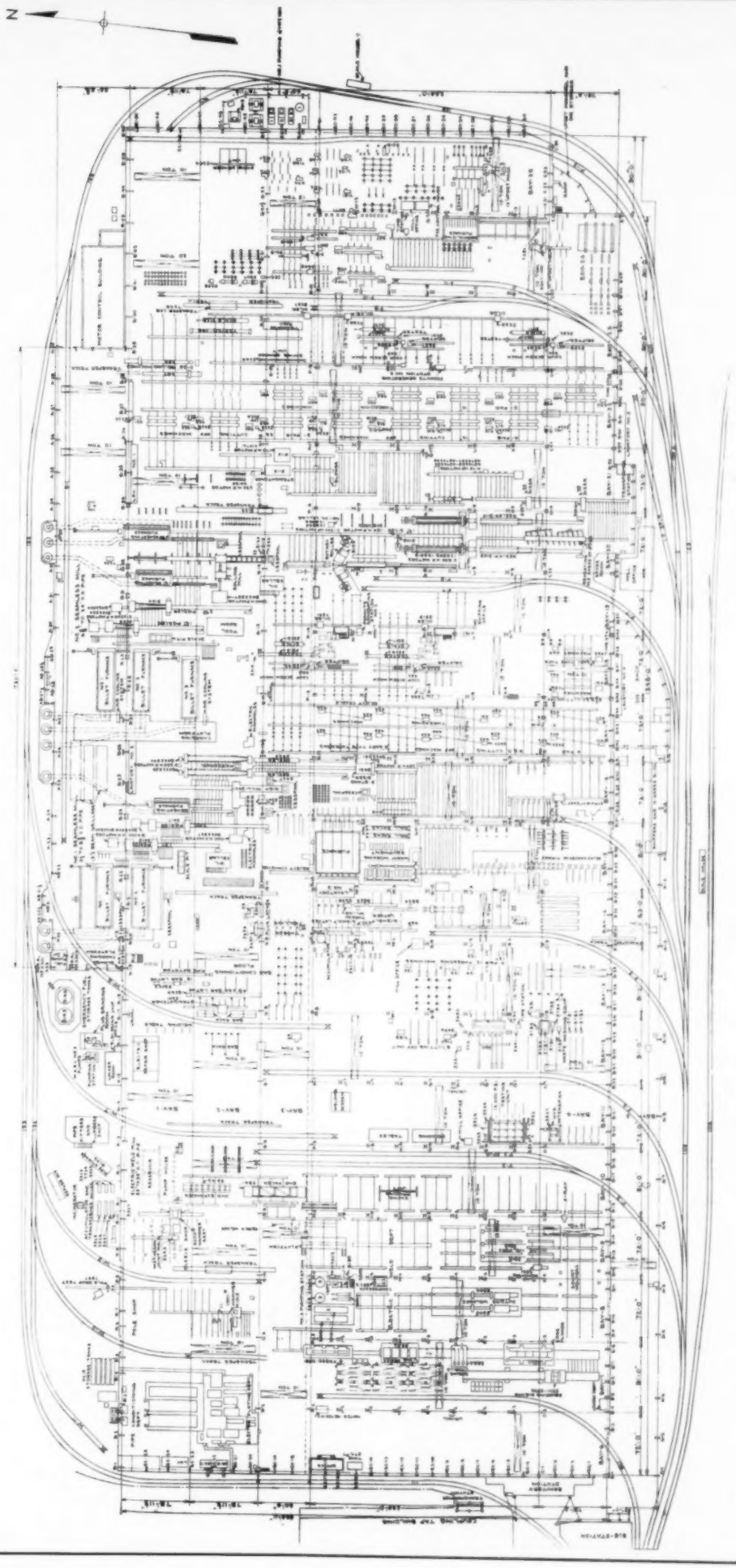


Figure 1 — Layout of 26-36 in. electric weld pipe mill of National Tube Co.'s McKeesport plant.

continuous running even during the breakdown of a major unit.

Although some utilities existed in the area, it was decided that this, and other new installations at National Works would be operated with 60-cycle power. There being no 60-cycle power generated at National at present, arrangements were made for the purchase of power from the Duquesne Light Co. A 23-kv substation to supply both the electric weld and the new boiler house, was installed at the edge of the company's property and 23-kv, 3-phase cable run to an outdoor substation in the immediate area of the electric weld mill.

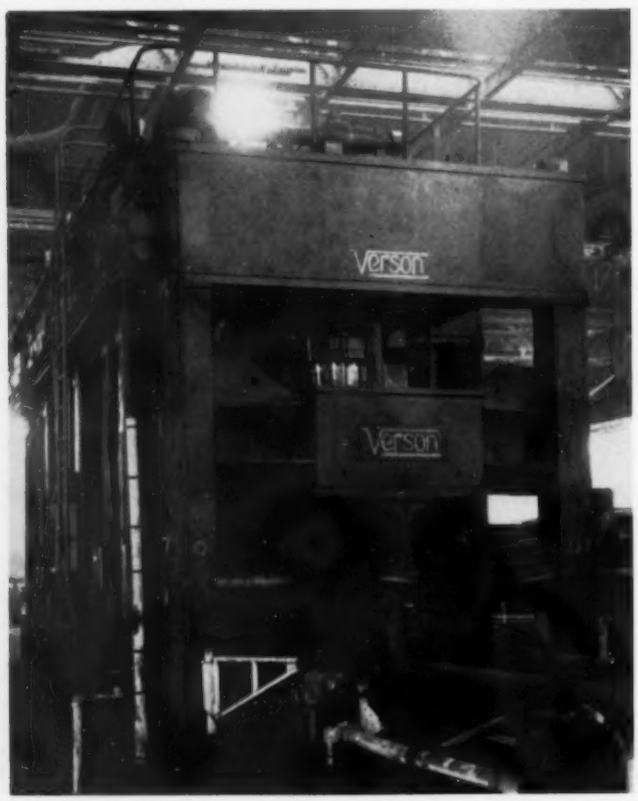
From this point power is carried at 2300 v to the main switchgear. Distribution through the area is at 440-v, 3-phase, supplied by three unit substations mounted at selected load centers. Two of these units are of 1000-kva capacity and the third of 1500 kva.

Direct current for magnet equipment and the adjustable speed motors on the planer is obtained from the plant's main bus.

A good deal of the handling of the product from the plate hoist to the final kickouts is done by air operated equipment. In addition, a number of the hand operations, such as grinding, chipping, etc., are done using hand pneumatic tools. A 3000-cfm air compressor was installed for this service, but rather than tying it to the electric weld mill, it was added to the plant air system. Because of the diversity of loads and the additional units on which the electric weld could draw, this appeared advantageous both to the old and the new units.

Although it was originally planned to shear the ends of the sheets at the pipe mill, a check of the plate indicated that the end shearing done at Homestead was satisfactory. The first operation, therefore, is planing the edges of the plate.

**Figure 2 — The pipe is formed into a U in a 2000-ton, 4-section press.**




A double edged plate planer is used for this purpose. The plate is clamped to the bed by hydraulically operated clamping beams. The edges of the plate are planed simultaneously by screw driven travelling carriages, each of which carries 12 tools which plane and bevel the edge of the plate. All cutting is done in one direction of travel, the carriages bringing in a plate on the return stroke. Each screw is driven by a 125-hp, d-c adjustable speed motor.

The plate is now ready for shaping into a can, the semi-finished pipe prepared for welding. In the first operation, the edges of the plate are formed for a distance of 10 in. from the edge to the radius of the pipe before expanding, using a three stand edge roll built by Consolidated Western Steel Corp. Although this step in the forming process is more applicable where the cans are formed in pyramid rolls, it allows the forming of the cans at lower pressures than would otherwise be required and with less headroom in the presses.

The "U"-ing operation is performed in a 2000-ton, four section press, as shown on Figure 2. The lower die consists of two rows of pivoted toggles which wrap the plate around the punch which constitutes the upper die. The four press sections are joined both mechanically

**Figure 3 — An 18,000-ton unit is used for the closing press.**

and hydraulically to constitute a single press 41 ft in length. Each press section mounts a 50-hp motor driving an oilgear pump. Provision has been made for decreasing the cycle time of the press by increasing the pumping capacity. At present, however, the presses are far from being a limiting factor in the operation. The dies are so designed as to allow the forming of pipe from 24 to 36-in. outside diam with wall thicknesses up to ½ in.

The closing press, shown on Figure 3, the final step in the forming operation, is an 18,000-ton press in three sections. In this press the three sections are mechanically and hydraulically separate, the levelling between press sections being accomplished by levelling valves, limit switches, and photo-electric relays. The press is raised and lowered by six double acting cylinders, two on each platen section.

In the closing direction, three large single action rams, each 5 ft 10 in. in diam, are connected to the oil system for the power stroke.

The dies are cast iron nickel alloy inserts in a fabricated die holder. They consist of half cylindrical segments split and relieved on the horizontal axis.

The degree of closure of the finished can can be controlled by the shape of the "U" and the pressure exerted in closing. At the present time the cans are so formed that the gap between the edges varies from one to three in. which is quite satisfactory for the outside welders.

The cans are carried through the presses on rollers which are affixed to air cushions which extend up through pockets in the dies.

The formed cans first receive their outside diam weld. The outside welders, shown on Figure 4, were built by

**Figure 4 — Outside welders are shown running a seam at the top of the pipe.**

the Consolidated Western Steel Corp., at their Maywood, Calif. plant. The can is positioned with the seam up by jack rollers and then driven by an air powered chain conveyor, enters into the driving and positioning rolls of the welder. A separation beam extends through the seam of the can and aligns the edges. As the can is propelled forward, the can is more closely confined, rounded and the edges brought together. In the welding cage the can is supported from the outside by nine to thirteen roller beams depending on the pipe size, while pressure is exerted from the inside against this cage by an inside mandrel which also carries a water cooled, copper back up shoe against which the welding is done.

Before welding, the edges of the plate pass under a preheating torch operating at considerable pressure. In addition to the preheating and degreasing action of the torch, the velocity of the gases of combustion blow the plate clean of scale and dirt.

Welding is accomplished by conventional submerged arc welding, except that two welding electrodes are so spaced that they operate in a common pool of molten metal. Direct current rod feed motors pull the 3/16-in. bare electrode from 150-lb coils located over the welder. The motors are powered by a thyratron tube rectifier unit which is so biased as to vary the motor speed to obtain essentially constant voltage across the arc. In starting the weld, the lead arc rod is brought into contact with the plate. The low voltage across the contact resistance causes the motor to reverse through a retract mechanism until the preset welding voltage appears between the rod and the work. After a suitable interval the trail arc is started. In stopping the weld, the opposite sequence is followed, the trail arc being allowed to continue after the lead arc is extinguished to fill the crater made by the lead arc. Power is supplied by 1500-amp welding transformers connected in delta-delta. Such a welding arrangement permits welding the outside diam of pipe at rates of 55 to 75 in. per min depending on the plate thickness. In making the outside weld, an effort is made to obtain a consistent 80 per cent penetration of the thickness of the plate. The flux used in the submerged arc welding is flowed onto the pipe just before the first electrode. The unfused portion is removed by a suction system and immediately returned to the flux bins. The fused flux is broken from the weld and discarded, although this material is capable of reuse in less critical welding applications.

**Figure 5 — Pipe is turned so that the weld is made with the seam at the bottom when doing the inside.**

No effort is made to weld to the very ends of the pipe, several inches being left unwelded at each end. The length of the unwelded portion is determined by the spacing of the rolls in the welding cage, the welding being done only when the can is closed securely both before and after the welding arcs to prevent working the solidifying weld material. The ends of the pipe are then welded, starting from a "tab," a piece of plate of the same wall thickness as the pipe which allows the welder to achieve a steady state condition by the time the pipe proper is reached. The welder used, a manual unit or squirt welder is also a submerged arc type machine which automatically feeds rod to maintain a fixed arc voltage. The welding head is mounted on an electrically driven travel carriage to insure a steady rate of welding.

The inside weld is accomplished in much the same manner as the outside weld, with twin submerged arc equipment. Here, as shown on Figure 5, however, the welding heads are mounted in the end of a cantilevered boom which also carries a flux source and a vacuum system for the removal of unfused material. The pipe is positioned on an electrically driven carriage and the weld is made as the carriage runs over the boom, the retract speed being approximately three times the welding speed. The rod feeds through grommets mounted along the boom from overhead reels mounted at the back end of the welder.

In making the outside weld, the welding heads are guided accurately along the seam by a knife edged roller that rides in a kerf which results from the bevel given

the edge of the plate in the planer. When making the inside weld, however, no such easy method of guidance is available. The pipe has been too closely closed by the outside diam weld to permit tracking from the inside kerf and, in any event, there will always be enough weld metal achieving full penetration to make such a method of tracking impractical.

Actually the inside welder operator starts his weld on the inside seam at the end of the pipe where he can view the seam and, after the deposition of the flux or the can travel has made it impossible to follow by this method, he watches the heat of the molten pool as it reddens the outside weld reinforcement. This heat path the operator observes continuously in a mirror under the length of the pipe. The operator moves the pipe from side to side on the carriage with suitable adjusting screws available throughout the travel of the carriage to ascertain that the welds coincide. Not only does the heat of the inside weld offer a means of guiding the weld, but the heat refines and normalizes the material of the outside diam bead. Figure 6 shows the polished cross-section of a typical welded section.

The mill at National Works employs three such inside diam welders, two made by Consolidated Western and one made by the National Tube Co. Two of the welders employ direct current generators for the lead arc and transformer type welding for the trail arc, the one built by National Tube Co., however, employs transformer type welders connected in delta.

The making of the inside weld is more critical than the making of the outside weld because the pipe is now electrically and mechanically closed and the configuration of the welder itself presents electrical problems in the way of magnetic disturbances. Not only is the weld made at a slower speed than the outside diam weld, but it has been found desirable to solidly ground the pipe during the operation instead of relying on shoes or other sliding contacts.

After welding, the pipe is carefully inspected inside and out for possible weld and plate defects. Pinholes in the weld, small undercuts, etc., are repaired by squirt welding. The weld reinforcement of the inside weld is chipped back for four to six inches, depending on the customer's requirements to facilitate field lineup. Close liaison between the inspection crew and the welders is maintained so that any necessary adjustments are made quickly to minimize the amount of repair. All pipe are again inspected after repairs to see that the repairs are complete and workmanlike before the pipe are sent to the expander.

The hydraulic expander, shown on Figure 7, the only new step in the process over National's previous process of manufacturing fusion welded pipe, has the combined functions of cold working, rounding, straightening, and testing the pipe. As indicated previously, the expander has the task of raising the yield point from the 44,000 to 50,000 psi in the plate as received to a minimum of 52,000 psi, and 72,000 psi ultimate in the finished pipe. Actually because of variations in composition an average yield of 57,000 psi is the mill goal.

One piece of plate from each heat is "piloted" through the mill, expanded, and tests cut and pulled and used to check mechanical properties and composition before the remainder of the heat is run.

The pipe is conveyed to the expander, as it is between

**Figure 6 — Good weld quality is obtained as shown in this polished cross-section.**

all other stations, on conveyors that consist of unpowered spools mounted between channel sections. The power for the conveyors is provided by motor driven rubber covered friction rolls, which are spring suspended beneath the conveyors so as to contact the pipe at 25-ft intervals. Such a conveyor is flexible in application and readily allows for changes in pipe size.

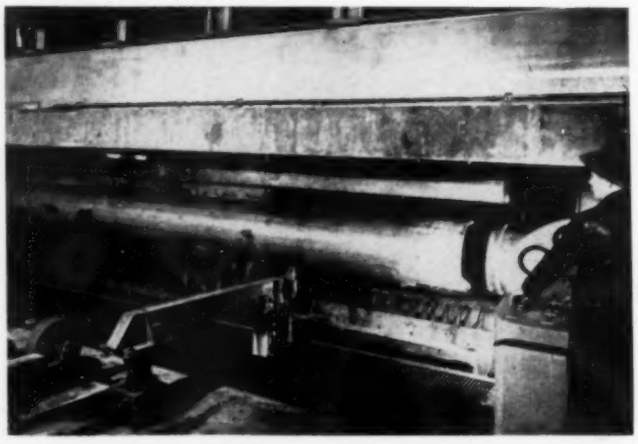
The pipe is kicked broadside into the expander and the ends are mechanically belled to the proper outside diam by hydraulically driven truncated cones which also carry the sealing rubbers used in the hydraulic expansion of the pipe body. The hydraulic cylinders driving the end belling device are the same ones used to provide head pressure during the expansion process and have an area slightly larger than the cross-sectional area of the pipe.

Following the end belling, dies hinged at the bottom are lifted around the pipe and secured with a recessed lock bar which engages the tops of the dies.

Fill water is then introduced from three 5000-gpm pumps which complete their fill at a pressure of 80 psi. The whole expander assembly is inclined seven inches in its length to assist in bleeding the air from the pipe during the fill process.

Following the fill, expansion water is admitted to the body of the pipe and to the head pressure cylinders. The material begins to flow out against the dies and the head cylinders follow in as the pipe shortens. Expansion is complete when the material just back of the mechanically belled ends, which is in effect a corrugation of the pipe, have been forced out against the die.

**Figure 7 — The hydraulic expander straightens, rounds, tests and improves the quality of the material in the pipe.**



Pressures for the expansion of 30-in., 0.325-in. wall pipe approximate 1700 psi although the expansion begins at a much lower pressure.

The water for the expansion process is obtained from an air ballasted accumulation system of 90 usable gallons and fed by three 37.5-gpm pumps, driven by 75-hp, 3-phase induction motors. Control of this accumulation system is such that the pressure can be regulated at any level up to 3000 psi for the smallest diam, heaviest wall pipe for which the mill was designed.

After the expansion process, the pressure is bled down to the test pressure indicated in the contract which is normally 90 per cent of the maximum yield value, and the dies opened. The pipe is struck near the weld at each end with a two pound air driven hammer and the test pressure held for 10 seconds. The pressure is then further lowered to between 300 to 500 psi and the seam inspected for leaks. Test and inspection pressures are obtained from the expansion water accumulator through suitable reducing valves.

The water is then drained from the pipe as the heads are retracted and the pipe discharged onto an inclined conveyor that allows additional drainage.

All the operating parts of the expander, die closing, lock bar, and the pull back of the head operate from a 120-usable gallon, 1200-psi air ballasted accumulator system supplied by three 50-gpm, 1200-psi triplex pumps, driven by 50-hp induction motors.

Water for filling the pipe contains 1 per cent soluble oil and is recirculated. Because of scale and flux which eventually contaminate the water and cause excessive wear in valves, pumps, and packing, only clean water is used for the actuating and expansion functions.

Following expansion and test, the pipe is end faced as the final manufacturing operation. The ends of the pipe are faced simultaneously. The pipe is chucked internally by a hydraulically expanded mandrel. A cutting head, driven by a variable speed drive and carrying three tools, two bevelling and a facing tool, bevels the ends of the pipe 30 degrees from a plane normal to the pipe axis to facilitate field welding and the facing tool cuts a $\frac{1}{16}$-in. normal face against which adjacent sections are aligned.

Final company inspection checks not only the results of the expansion and end facing operations but the previously inspected weld quality as well.

Both the inside and outside welds are examined inch by inch, the inside by crawling through the pipe on a buggy. The plate is reinspected for surface condition as the drastic treatment of expansion will reveal plate defects not at all apparent in the previous stages of manufacture. Dimensional tolerances of wall and circumference are checked, as well as the appearance and accuracy of the bevel.

As a further check of pipe quality, about 5 per cent of the product is X-rayed as a quality control measure.

Minor defects which may appear after expansion are repaired by welding and grinding. Any welding done after expansion is accompanied by thorough preheat. The piece is retested by sending it through the complete expansion cycle.

The pipe is then examined by the customer's inspector who not only verifies the findings of the company inspection, but has access to all previous inspections and processes through which the pipe has passed.

Shipment is made from skids after inspection. A spreader capable of handling three pipe at a time loads the pipe into suitably prepared gondolas.

# DISCUSSION

PRESENTED BY


JOHN L. YOUNG, Vice President-Engineering, United States Steel Co., Pittsburgh, Pa.

RAYMOND L. CAREY, Tube Mill Engineer, Jones & Laughlin Steel Corp., Aliquippa, Pa.

G. C. ANDERSON, Superintendent, Electric Weld Mills*, National Tube Div., United States Steel Co., McKeesport, Pa. (*At time of paper presentation.)

WRAY DUDLEY, Engineer, Patterson-Emerson-Comstock, Inc., Pittsburgh, Pa.


**John L. Young:** The author referred to this pipe being manufactured in 40 ft lengths, whereas previously all such pipe had been made in maximum lengths of 32 ft. The problem of increasing the length seemed rather simple at the time the appropriation was granted, but it was not long afterward that we found we were into an entirely new problem. Previously the 32 ft lengths had been formed primarily on bending or pyramid rolls, but the additional length eliminated that possibility, as pointed out by Mr. Anderson in his paper, so we found we had to start from scratch. The two presses Mr. Anderson described were completely developed and built within the time of the construction period. The whole plant was designed and built in eight months, including the presses. They were of an entirely new design. I might add that they have been entirely satisfactory and, since the installation at McKeesport, have been duplicated elsewhere.

**Raymond L. Carey:** I would like to ask what the approximate time would be to change mill rolls, dies, etc. in preparation for rolling a new pipe size on the mill?

**G. C. Anderson:** I would say that three days represents the average time for size change on a mill of this type. Changes in wall can be readily made since most of the machines other than belling machines work on the unchanged outside diam of the pipe. Our range of 26 to 36-in. outside diam is covered by new dies for the forming press and expander for each size, while the welders cover the range in three steps, each of which requires partial replacement of the guiding elements.

**Wray Dudley:** I should like to ask what is the overall kwhr consumption per foot of pipe, for say 36-in. × 0.312-in. pipe.

**G. C. Anderson:** The power consumption for forming, welding and expanding 30-in. outside diam × 0.312-in. wall pipe is approximately four kwhr per foot. This includes all the necessary auxiliary functions such as heating, lighting, cranes and air compressors. Our situation is unusual in that we use both 25 and 60-cycle power in addition to d-c. Our air compressors are tied to a shop system so that we may be using more or less air than we actually compress at this location.

# CHARACTERISTICS AND OPERATION OF COAL AND ORE BRIDGES

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*. . . . careful engineering in motor selection and control will pay off in adequate and economical bridge operation . . . .*

▲ *Bucket hoist drive* — The bucket hoist drive on bridges of modern design involves two duplicate engines, one for the hold line and one for the close line. Each engine includes a motor, a reducer, a drum and a motor brake, all on a common bed plate. These engines are operated by their magnetic controllers to perform all the motions and speed changes required for handling the bucket so as to deliver or absorb energy to or from the system without the use of load brakes, or drum clutches.

The modern bucket hoists for coal and ore bridges, with which the writer is familiar, have all been of a tonnage capacity range that involve either one of two sizes of AISE Standardized mill type 230 v d-c motors (see AISE Standard No. 1). These are the frame 616 and frame 618 or the similarly rated frame numbers which they have superseded.

The frame 616 motor or a motor of equal rating has been applied on hoists ranging in capacity from 10 net ton to 12 gross ton. The frame 618 motor or a motor of similar rating has been applied on hoists ranging in capacity from 15 net to 22.5 net tons including 15 gross, 17 net and 17 gross ton ratings. The hoisting speed in each case was adjusted for the different loadings to keep within the motor rating. Protected frame motors with either self or forced ventilation are normally used for bucket hoist service to obtain sufficient thermal capacity from the motors. The use of forced ventilation is to increase thermal capacity only, and does not enter into the selection of motor frame size. Motors are applied on the basis of the 1-hour protected rating being about equal to the hp required to hoist the full load at the selected hoist speed. Forced ventilation, if supplied, is provided only when the frequency of the hoist cycle is such as to require a higher thermal rating of the motor than is available in the self-cooled frame.(1)*

Published ratings of these two AISE Standardized series wound, 230 v d-c protected frames are given in Table I.

**TABLE I**

**75 C Temperature Rise**

| Frame size | ½-Hr rating hp | Enclosed speed | 1-Hr rating hp | Self cooled speed |
|---|---|---|---|---|
| 616 | 200 | 400 | 187½ | 410 |
| 618 | 265 | 385 | 250 | 380 |

**Continuous 75 C Temperature Rise**

| Frame size | Self cooled | | Forced ventilation | |
|---|---|---|---|---|
| | Hp | Speed | Hp | Speed |
| 616 | 150 | 450 | 187½ | 410 |
| 618 | 200 | 410 | 250 | 380 |

The ½-hr ratings are the recommended maximum for use in calculating full load hoisting speed. After the hoisting speed is established it is necessary to summarize the motor heating for each part of the cycle to determine if the self-cooled or forced ventilated frame is required. A detailed calculation is included in reference.(2) If the rms load calculations show the motor to be inadequate, then the full load hoisting speed must be reduced or a larger motor used. The frame 616 motor has been satisfactorily applied on a number of bucket applications — ranging from 10 net tons at 250 fpm up to 12 gross tons at 200 fpm. The frame 618 motor is used for heavier loads from a range of 15 net tons at 230 fpm to 22.5 net tons at 170 fpm.

Where more capacity is required the motor speed can be increased by applying adjustable d-c voltage to shunt would motors.(3) With the maximum torque limited by

*Numbers refer to Bibliography at end of this paper.

a rotating regulator, the manufacturers of mill motors approve of increased horsepower loadings obtained at higher motor speeds by applying voltage above the nameplate rating. Two times rated voltage has been approved for cyclic types of loads such as grab bucket applications. On the basis of 440 volts applied for obtaining rated hoisting speed, these two frame sizes will develop the hp outputs given in Table II.

**TABLE II**

| Protected frame shunt wound | Hp | Rpm | 1-Hr torque, lb-ft |
|---|---|---|---|
| 616 | 360 | 885 | 2150 |
| 618 | 480 | 805 | 3130 |

Thus a 91 per cent increase in loaded bucket weight or in hoisting speed is possible by use of overvoltage on the shunt wound motors. This required a corresponding increase in gear ratio between the motor and drum. The thermal rating of this type motor is increased by a greater ratio than the 91 per cent due to more efficient cooling at the higher average speed.

Several applications have been estimated or designed in which overspeed obtained by overvoltage was used to reduce the required motor torque below the rated value and thus avoid the need for forced ventilation. This is particularly desirable on the newer type of turntable trolley on which the two hoist engines are mounted on a rotating base.(4)

The use of adjustable d-c voltage for hoist drive permits the use of the frame 616 shunt motor in place of the frame 618 series, 230-v motor for bucket capacities ranging from 15 net tons to 22.5 net tons. This is true providing the full load hoisting torques and the rms torque for forced ventilated applications do not exceed 2150 lb ft. The rms torque for self-cooled applications should not exceed 1710 lb ft with a full load hoisting torque of 2150 lb ft maximum. The lower motor torque, as a result of higher gear ratio, also permits the application of a 3600 lb ft instead of a 6000 lb ft motor brake. This reduction in motor size reduced the trolley weight by nearly 3 tons due only to difference in weight of motors and brakes. Further savings in weight have been made by the use of corresponding reduction in the weight of the control equipment. It should be noted that overvoltage, overspeed operation on adjustable voltage drives should be carried out only far enough to satisfy the torque and thermal rating of the motor. To go farther than necessary in this direction adds needlessly to the kilowatt rating and cost of the motor-generator equipment supplying the load.

When the adjustable voltages hoist drive is used, each motor is fed by an individual generator on a common shaft. Speed adjustment and direction of motor rotation is obtained by controlling the associated generator field strength and polarity. This type of drive with torque limit control provides ample torque for accelerating and hoisting rated load without subjecting the ropes and gears to the excessive peak loads that are inherent with the conventional series motor type of drive.(4) Retardation and bucket lowering are done by feeding regenerated power back into the system. This plus the absence of power loss in series resistors during acceleration results in a substantial saving in power consumption per ton of material handled.

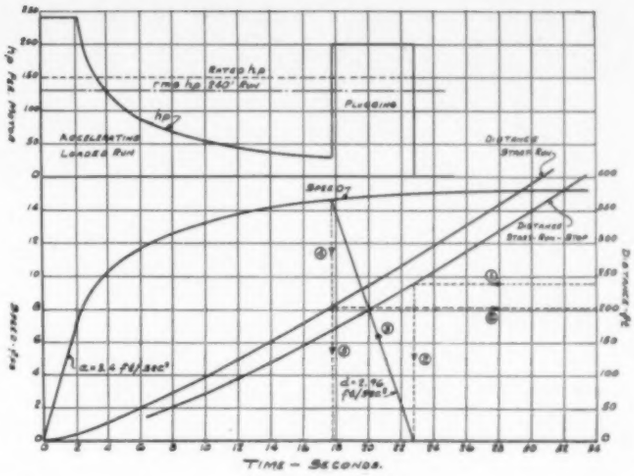


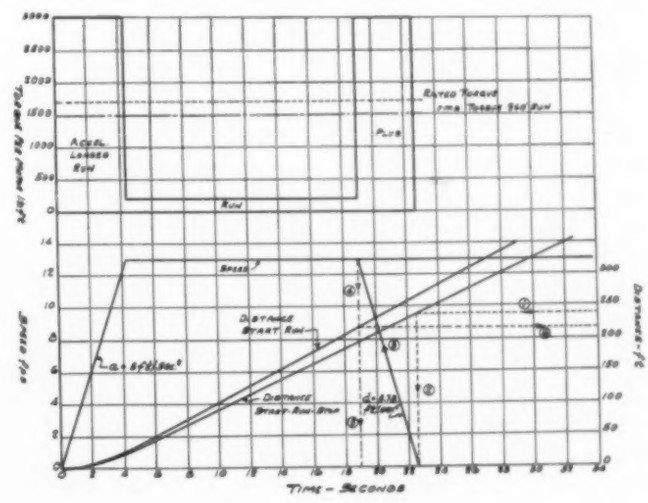

**Figure 1 — Trolley performance curves — series motors**

*Trolley drive* — The trolley drive on modern bridges consists of two motors driving the two axles through single reduction gears. A motor brake for each drive is provided for use in parking and for emergency stopping. All normal stopping or slowing down is done by plugging and/or dynamic breaking magnetic control.

Modern trolleys equipped with 10 to 12-ton buckets are driven by two frame 612 or frame 14 AISE standardized 230-v, d-c series wound motors. In the protected frame these motors are rated 94 hp, 1 hr, and 75 hp continuous when self ventilated and 94 hp continuous when forced ventilated. Of a total of five trolleys of this rating range built in recent years, all were provided with forced ventilation for both trolley and hoist motors. These trolleys ranged in weight from 166,000 to 196,000 lb and were geared for a top speed ranging between 700 and 1180 fpm. It is probable that forced ventilation was not an absolute necessity in all cases, being supplied for reasons of duplication of design or to take care of future faster cycles.

Modern trolleys weighing from 250,000 to 275,000 lb loaded and equipped with 17 to 22.5-ton buckets are

**Figure 2 — Trolley performance curves — shunt motors.**



driven by two frame 616 or frame 18 AISE standardized 230 v d-c series wound motors. In the protected frame, these motors are rated 187½ hp, 1 hr, and 150 hp continuous when self ventilated and 187½ hp continuous when forced ventilated. Of eight trolleys in this size range, only two were equipped with forced ventilated motors. These larger bridges have longer spans which result in more running time at higher speed which lessens the need for forced ventilation. The top speed of these trolleys ranged between 800 and 1200 fpm with most being geared for 900 fpm.

One 227,000-lb, 17-ton bucket trolley was designed for 900 fpm using two frame 614 protected, self ventilated motors rated 125-hp, 1-hr, and 100 hp continuous. This bridge has a 500-ft span and the longer running time, which is at light load, makes it possible to use these smaller motors.

Trolley drive motors are selected so as to have sufficient torque for rapid acceleration and deceleration on a continuously repeated cycle. The high inertia of the load and the acceleration are the predominating factors in determining the correct motor size since the friction and windage losses are relatively small. The motor is selected on the basis of the average torque while accelerating, with resistance in series with the armature being held to twice the continuous rated torque of the protected frame. A motor size is chosen such that the accelerating torque of the above rule will produce an accelerating rate of from 2.5 to 3.5 fpsps. The decelerating rate is within the same range and is obtained by a plugging torque of 1.5 times the continuous rated torque. The trolley reaches approximately half speed in two to three seconds at the maximum accelerating rate, and the remaining accelerating is done at a progressively lower rate. This results in the trolley not reaching its full speed until near the end of the trolley runway. Specifying the top speed for a trolley driven by series motors does not mean much unless the distance traveled in reaching top speed is also given. If the motor speed for top trolley speed is selected exactly equal to the torque of the running losses, it is likely that the trolley would have to travel a much longer distance than the length of the trolley runway before reaching the selected speed. It is recommended that the gear ratio be based on a motor speed somewhat below the value corresponding to the friction losses.

*Maximum acceleration* — It is essential that motor rating, control design and gear ratio and wheel radius be co-ordinated to avoid danger of wheel slippage when the trolley is started and stopped. Too high a gear reduction — wheel radius ratio or arbitrarily applying an oversized motor without special resistor selection — can easily result in wheel slippage with resultant flat wheels and dangerous operation. Maximum acceleration determination should take into account the lighter weight on the wheels when the bucket is empty. Assuming a ratio of 0.85 for weight of trolley with bucket empty to bucket loaded and a coefficient of friction of 0.15 the maximum permissible acceleration is "a" = $0.15 \times 0.85 \times 32.2$; "a" = 4.1 fpsps. Maximum deceleration should not exceed about 0.9 of "a" or 3.7 fpsps. However, these are average values for the entire period on resistance, and the peak values of torque resulting from contactors closing around resistance steps will be greater and would probably cause slipping. No thorough field measurements are available to show limiting values, however, past experience indicates that about 3 to 3.5 fpsps is about the upper design limit.

Wet or frosty rails will reduce the cohesion between rail and wheel and increase the tendency towards skidding. On the same basis as above, a coefficient of friction of 0.1, which is reasonable for wet rails, would reduce the maximum permissible acceleration and deceleration to 2.64 and 2.38 fpsps respectively. The operator should use sand under this condition and should also handle his master switch with some restraint. Acceleration of the order of 5 fpsps, average during speed change, would appear to be somewhat exaggerated as this would require a coefficient of friction of about 20 per cent which is somewhat optimistic. This subject will bear watching in

**Figure 3 — 12-ton coal bridge with hopper, power is collected at 2300 volts, 3 phase, 60 cycle and converted to 230 v d-c by a motor-generator on the shear sill.**

comparing specifications of bridges since a few liberal assumptions of this nature can result in a favorable margin of "on paper" tonnage. Rather elaborate testing is required to actually measure acceleration.

There is no point in designing for too fast an acceleration which would result in discomfort and a feeling of insecurity to the operator. There have been some cases reported where operators have objected to discomfort and fear caused by too much speed or too rapid acceleration.

*Maximum speed* — The horsepower required to accelerate a trolley in a given time is proportional to the speed squared. Thus it requires about 78 per cent more power to gear a trolley for 1200 fpm than for 900 fpm, and the difference in cycle time could be very little for the normal length of runs. Long bridges with the loading out end opposite the incoming end may justify the higher speeds, but in most cases a somewhat faster acceleration and lower top speed will get more work done with less heating of the motors.

The trolley speed selected must take into account the ability of the bumpers to absorb the energy of the moving trolley. Modern design provides automatic slowdown and stop features in the control setup for the end zone protection. The higher the speed, the farther these protective features have to be located from the end of the runway to afford proper protection. This may result in an excessive high speed design causing the automatic slowdown points to be located well out into the working area of the runway and thus partly nullify the gains expected from the higher speed.

**Figure 4 — Front view of one-half of control in trolley house for hoist and trolley motors for bridge shown in Figure 3.**

Figure 1 shows a typical graph of trolley performance data for a 275,000-lb trolley driven by 2 frame 616 protected self ventilated motors. The first part of the speed curve shows the constant acceleration on series resistance to a speed of 7 fps and a decreasing acceleration from there on to slightly over 15 fps with 230 volts on the motor. The distance-time curves show the time required to travel a selected distance either without stopping or including stopping time. The illustration shows that the time and distance increments for a cycle distance of 240 ft are as follows: total time = 22.8 sec, accelerating time = 17.8 sec, decelerating time = 5.0 sec, stopping distance = 36.5 ft. Similar information for any other selected distance may be obtained from the curves.

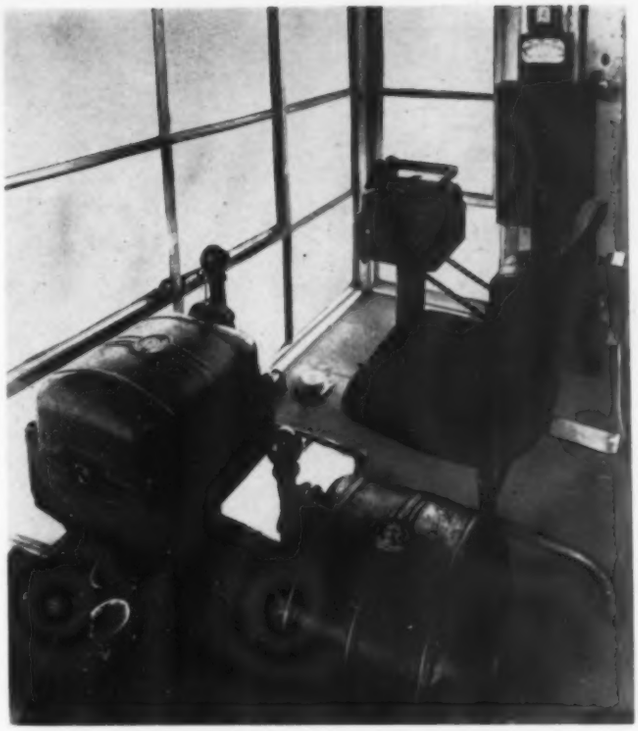


**Figure 5 — Interior view of operator's cab on trolley for bridge shown in Figure 3.**

The hp-time curve, in the upper part of Figure 1, shows the hp per motor for each part of the loaded bucket half of the cycle with the rms horsepower indicated for a complete 66-sec cycle.

Figure 2 gives performance curves for the same trolley driven by the same frame size motors except shunt wound and supplied by an adjustable voltage generator. The calculations are based on the same travel time for a 240-ft run. Since constant acceleration is maintained to the final speed, it is only necessary for this speed to be 780 fpm instead of 900 fpm for the previous example. Stopping distance from full speed is only 22.4 ft or 14.1 ft less than for the higher speed trolley, and the duty on the end bumpers is reduced by approximately 25 per cent. On cycle runs less than 240 ft, the adjustable voltage trolley is faster than the constant voltage trolley even with the lower top speed.

The upper curve of Figure 2 shows the motor torque for each part of the loaded bucket half of the cycle and the rms torque for a complete 66-sec cycle. Figure 2 curves are based on 325 volts applied to the motors for full speed of 780 fpm corresponding to 650 rpm of the motors. The overvoltage was limited to this value to get a direct comparison of the two types of drives with a minimum size of generator. The shunt motor is capable of greater output at higher voltage and speed.

*Bridge drive* — Bridge drive speeds range from 65 to 150 fpm with 90 to 100 fpm being most commonly used. Enclosed gear reductions are used between motors and wheels with the modern trend favoring a worm type reduction.[5] No attempt is made here to describe the variations in truck designs which are influenced by wheel loadings and the type of runway construction.

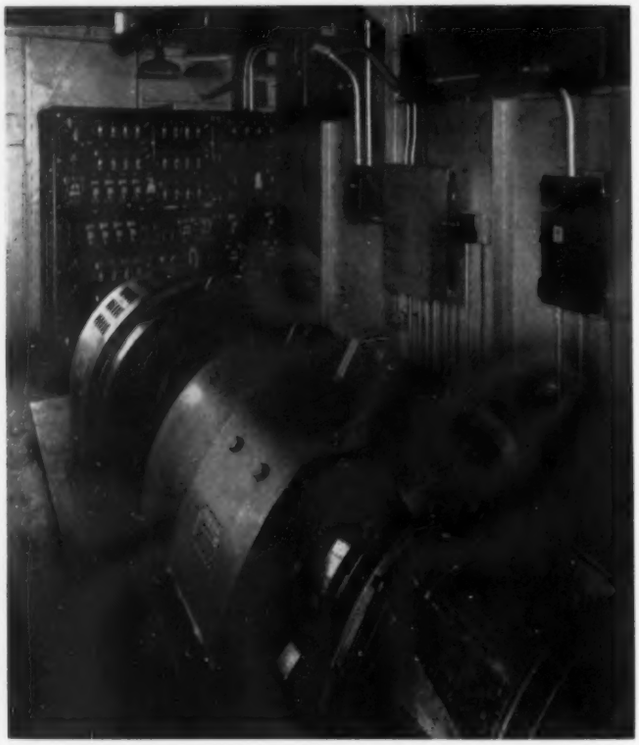


**Figure 6 — Interior view of motor-generator house on shear sill of bridge shown in Figure 3, also shows shear leg and hopper gate controller.**

The service is intermittent and the surroundings are dirty, so that totally enclosed mill type motors are used and are applied on the basis of their 30-min rating. Each motor is equipped with a full torque brake and each end of the bridge is supplied with one or more automatic rail clamp devices.

Of the modern bridges investigated, most of the 10 to 12-ton sizes were powered by four 33-hp motors, with two being driven by eight 19-hp motors. The larger bridges are driven by either four 45-hp or four 65-hp motors depending on the speed and weight.

Compound wound, 230-v, d-c motors are most commonly used, controlled in parallel and including two armature shunt speed points. This is done to permit running and slowing down when the bridge is traveling with a strong wind which causes the bridge to overhaul the motors. Wind load is the predominating influence in selecting motor size for bridge drive. The starting load against a 5-lb wind is nearly two times the load for starting with no wind. The running load against a 5-lb wind is three times higher than for running with no wind, and to start against this value of wind resistance requires approximately five times the effort as for running with no wind. These relations indicate that several factors need be considered in selecting motor size.

Test results on one bridge have been interpreted to indicate the starting effort required is about 45 lb per ton and the running force at about 15 lb per ton. These tests were not conclusive since only one example is involved and the air temperature was mild.

Two bridges are being built using a total of twelve 19-hp shunt wound motors for bridge drive. These two groups of six motors are supplied from the two adjustable voltage generators that are also used for the hoist drive. This scheme will provide stepless acceleration and deceleration and will allow less overnormal speed when traveling with the wind than does the compound motor scheme. Constant voltage rheostatic control for multiple motors is costly, so that adjustable voltage operation of bridge drive offers economies particularly when as many as eight or twelve motors are involved.

*Rail clamp drive* — All modern bridges have been equipped with automatic rail clamps as a protection against high winds. These involve mechanical clamping jaws that are released by a motor raising a weight which when down sets the clamps on the bridge runway rails. The weight is held in the raised position by a power set spring released brake on the motor shaft. This assures that the clamps are set on power failure which is a necessary safety precaution. These drives are each powered by a Frame 2, or 603 mill type, series wound, 230-v, d-c motor. One motor usually handles two weights. The control which provides for dynamic braking lowering of the weights is included with the bridge travel control on the bridge sills.

**Figure 7 — This 17-ton coal bridge with apron is used for ship unloading and stocking service.**

## MISCELLANEOUS DRIVES

*Apron hoist* — Bridges are being used more extensively for unloading directly from barges or ships in which case they are equipped with an apron which must be raised to a near vertical position to clear the harbor line. The drive engine consists of a motor, brake, reducer, drum and an emergency brake all mounted on a common bedplate. Series or compound wound mill type motors are normally used, and the control provides for dynamic lowering. Motors are applied on their 30-min rating and are usually of the 45-hp, or 65-hp size depending on the load and hoisting speed.

*Turntable* — Boat unloading bridges are being built with the hoist engines mounted on a turntable to improve operation of the bucket in the ship hold. The turntable drive requires a small constant speed motor of about 7½-hp rating. Either an a-c or a d-c motor is suitable depending on the kind of power available.

*Hopper gate drive* — Where the bridge carries a hopper for loading into the transfer car, a motor operated

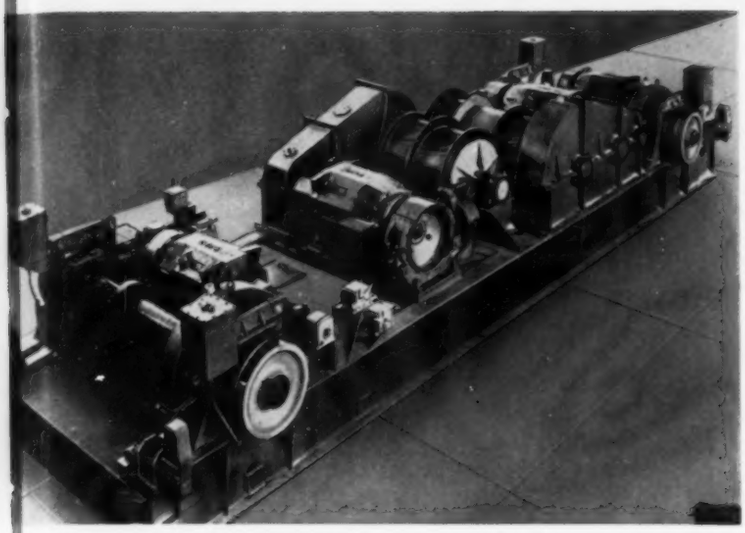


**Figure 8 — Shop view of trolley for 17-ton coal bridge shown in Figure 7.**

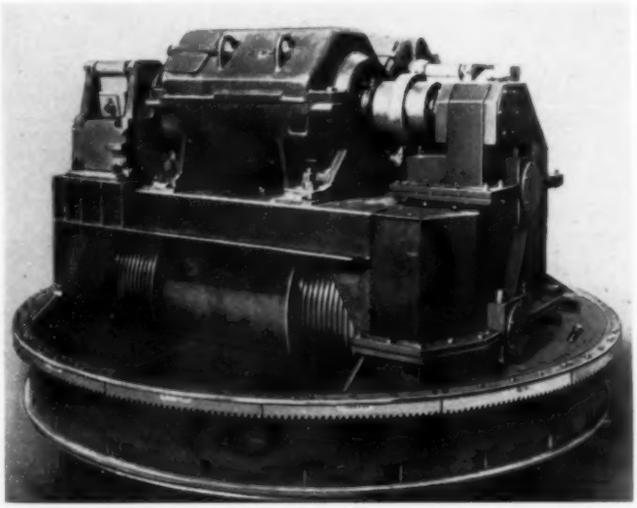
gate is sometimes applied. This involves a small mill type motor on d-c jobs supplied from a magnetic reversing controller.

## CONTROL

A complete discussion of all the features required of the magnetic controllers and brakes for all the drives on a bridge is beyond the scope of this paper. The control engineer can justifiably say that the motors and machinery are helpless to perform their duties unless directed and protected by control of adequate design and construction. The bridge designer is sometimes disturbed to have to provide so much space for the control which has sometimes been given the uncomplimentary name of "clap-trap." This humorous jibe probably is the outgrowth of the transition of controllers from the manual drum type to the much more reliable and better performing magnetic type which does require more space.

The main features of a modern bridge control system are briefly as follows:

**Figure 9 — Turntable type bucket hoist engine for 12-ton ore bridge.**



*In the trolley house* — For the two hoist motors, two magnetic, reversing, dynamic lowering controllers with overload and undervoltage protection including factory assembled and wired NEMA class 172 non-breakable resistors with series relays for shunt wound brakes and with a jam relay on the close controller. Series wound brakes have been applied on a derated torque basis where the coil heating was calculated to meet duty cycle requirements.

For the two trolley motors, one duplex, reversing, plugging, dynamic braking controller with overload and undervoltage protection also including factory assembled and wired NEMA class 172 non-breakable resistors. The controller should include equipment for providing two points of automatic slowdown and final stop protection in each of the two runway end zones and should also control the automatic application of sand ahead of the trolley wheels in case of automatic slowdown.

For the main circuit and bridge circuit, panel mounted contactors and miscellaneous power knife switches for providing means of disconnecting all power to the trolley and for disconnecting the bridge power circuits between the trolley and bridge drive controllers including overload protection to the feeders should be provided.

*In the trolley operator's cab* — Two cam type master switches for the bucket hoist, one for the trolley drive and one for the bridge drive controllers.

Foot switches for the trolley brakes, sanders and bridge feeder contactors.

A remote push button for the main circuit contactor.

Miscellaneous items such as a heater and cab light and working lights.

The trolley should also be equipped with a control type overhoist limit switch, trolley travel limit switches, and a trolley speed measuring device.

The bridge travel and rail clamp control is usually provided in two factory assembled units, one for each end of the bridge.

Each controller should provide for overload protection and reversing multispeed control of the bridge drive motors, in parallel, as well as rail clamp control previously described.

Modern bridges are equipped with one or two anemometer equipments which measure and record wind velocity and operate auxiliary relays for use in interlocking with the bridge drive and rail clamp controls.

A control circuit cam type limit switch is standard equipment on each leg of the bridge for controlling the speed of the faster moving end of the bridge to prevent over skewing. Each leg is also provided with a power circuit limit switch connected to interrupt power to the bridge moving controllers in event of failure of the control skew protection.

## CURRENT COLLECTORS AND WIRING

Space does not permit a complete description of wiring and signal devices. The power is applied to the bridge through collectors from conductors along the bridge runway. The trolley runway is usually provided with two main power conductors, three bridge power conductors, and three bridge travel control conductors

where control of bridge movement is required from the trolley cabin from any position on the trolley runway.

## CONCLUSION

This paper has attempted to cover in a limited space what are some of the more important electrical features of modern coal and ore bridges. These comments should stimulate discussions and future writings that will provide a better understanding of the subject.

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# DISCUSSION

**PRESENTED BY**


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**F. Santiago:** Mr. Blankenbeker referred in his paper to the fact that shunt motors are used for variable voltage systems with high voltage applied to these motors. To keep the record straight, I want to point out that this high voltage is applied only to the armature, thus leaving the fields operating on rated constant potential d-c. The only objectionable part of the high speed obtained by this method is that some trouble may be experienced in mounting the new gear reduction on an existing design.

Variable voltage systems for bridge operation have been attracting considerable interest lately. I have one point to make in this respect which may be of interest to the manufacturers and the operators. The extra conductor rails required by rotating regulators is a source of maintenance trouble. Why cannot a bridge operate satisfactorily with regular Ward-Leonard system without rotating regulators? This would increase the reliability of the system and avoid the undesirable extra conductors and collector shoes. We have several Hulett unloaders working on variable voltage without rotating regulators and they have been giving satisfactory service for more than 20 years in some installations. Of course the regulators will provide for smoother acceleration, but is that as necessary as the reliability of the system? I would like to hear some comments from the electrical manufacturers on this point.

I question the advisability of having too many motors on the bridge travel drive; both from original cost and from the maintenance point of view. Sometimes oversize motors are used two in series and operated at half speed with 100 per cent full load torque with consequent lower gear reduction and smoother operation.

**H. H. Angel:** The accelerating and decelerating curves of torque, horsepower, and speed against time are of especial interest. When adjustable voltage control is applied to the hoist and trolley, it is stated that an appreciable reduction in trolley weight is made by using smaller motors and brakes, and eliminating the rheostatic control. I would like to know how much greater, if any, is the present-day first cost of using adjustable voltage control on the basis that ample constant potential power is available and the trolley designer might build a lighter type of trolley if he knew of the expected weight reduction. I would also like to learn if any excessive collector trouble has been experienced with this control when the rotating regulators and motor-generator sets have been mounted on the bridge structure.

The author points out that when series motors are applied to a trolley drive, the trolley reaches approximately half speed in two to three seconds at the maximum accelerating rate, and since the remaining accelerating is done at a progressively lower rate, the selected top speed might not be reached in the length of trolley travel and, therefore, it is recommended that a gear ratio be based on a motor speed somewhat below the value corresponding to the friction losses. I would like to know how frequently this is applied.

I quite agree with the author that 3 to 3.5 fpsps is about the upper design limit for acceleration. I know of several cases where it was necessary to reduce the accelerating rates, although these may have been in excess of designed rates.

On bridge travel drives, I understand that sleeve bearings for the wheel axles, in spite of being considered obsolete for electric overhead traveling cranes, are still recommended for this service, especially since more friction is offered against wind movements. I would like to know if many bridges are being built with roller bearing wheel journals.

**C. G. Dimitt:** There are a number of questions that we would like to ask Mr. Blankenbeker.

1. Protected type motors are recommended by the author for hoist and trolley drives. Enclosed type

motors are recommended for bridge drives because of dirty surroundings. Since the hoist and trolley motors are subjected to much of the effect of the same surroundings as the bridge drive motors, with exposure to rain, snow, and mill dirt conditions, what difficulties if any, have been experienced with protected type motors?

2. Mention is made of forced ventilation for hoist and trolley drive motors. Are these ventilating systems individual units for each motor or are they common systems feeding groups of motors, and what provision is made for filtering the blown air in either case?
3. Man trolley speeds of 700 to 1180 fpm have been mentioned, with slow down and stop limit switch protection.
   a. What provisions are made for "dead man" protection?
   b. Do slowdown limit switches function regardless of trolley speeds or do they function contingent upon trolley speeds?
   c. Do slowdown limit switches function independent of trolley master and controller position or do they function contingent upon trolley plugging not being applied?
4. Trolley accelerating speeds are given as averaging 3 to 3.5 fpsps. Cases of operator discomfort and insecurity have been reported due to high speed and rapid acceleration. What were the running and accelerating speeds in such cases, and have there been any reports of discomfort or insecurity during deceleration? If so, what were the deceleration rates?
5. For the bridge drive.
   a. What are the mechanical and electrical advantages of using two groups of six 19-hp motors?
   b. Where these groups of bridge drive motors are powered from the hoist generators, does this mean that the hoist cannot be used during a bridge movement?
   c. What provision for graduating braking is made during normal stopping, and during power failure stopping?
   d. Where but two motors per bridge leg are used, what provision is made to insure adequate braking when one brake is out of service for replacement of shoes, brake coils, etc.?
6. Where adjustable voltage drives are used, how many conductor bars are required to give adequate control and protection, first when equipment is mounted on the bridge structure, and second, when the equipment is mounted on the trolley?
7. Have adjustable voltage drive bridges been installed at docks where existing equipments using d-c power are in service? If so, how has this been accomplished; first, during the transition period if the d-c equipment is to be replaced with a-c, and second, where the existing d-c is retained for operating part of the equipment.

**S. Rifkin:** As Mr. Blankenbeker has indicated, limited time and space make it possible to cover only the more important electrical features of modern coal and ore bridges. Consequently, this discussion will be primarily restricted to the hoist and trolley motions, even though the descriptions of the bridge and miscellaneous drives were undoubtedly desirable in order to make the paper complete.

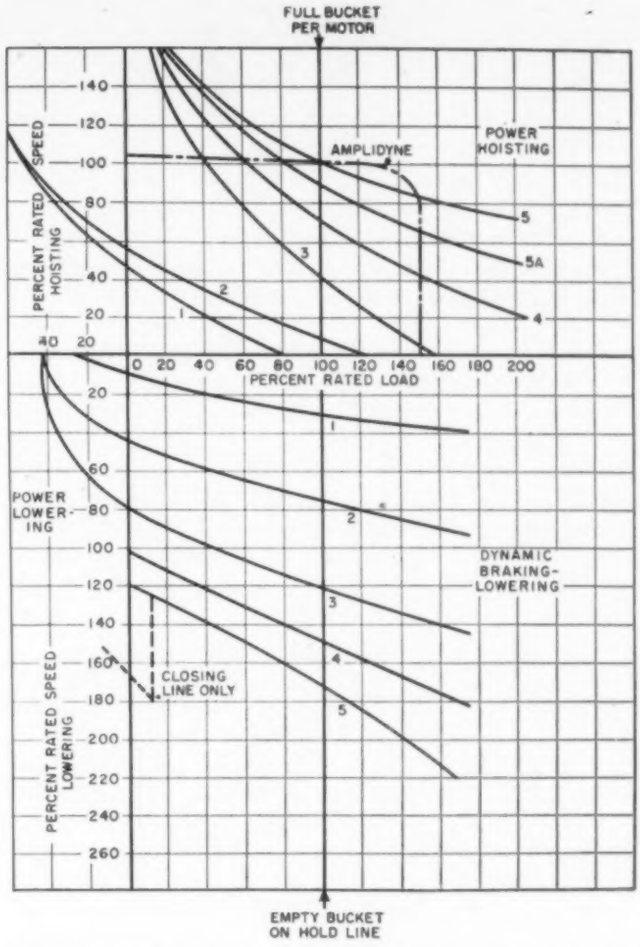


**Figure 10 — Chart shows hold and close line characteristics of hoist.**

The brief discussion of control equipment near the end of the paper was applicable only to constant potential installations. The jam relay that was mentioned in connection with the close controller is necessary to keep the operator from inadvertently lifting the loaded bucket entirely on the close line, with the holding line running slack. Continued operation of that nature might result in overheating the close motor. Furthermore, if the bucket is opened when the hold line is slack, the bucket will drop into the hold line and will subject the cable to considerable stress.

There is one other special feature associated with the close line that was not mentioned — the high-speed no-load lowering devices. When lowering the empty bucket, almost all of the bucket weight must be carried on the holding line. If there is more than a slight amount of pull in the closing line, the bucket will tend to close during the lowering operation. Figure 10 clearly illustrates the fact that the full-speed dynamic-braking lowering characteristic provides a faster speed with an overhauling load than with no-load. In order to match the lowering speeds of the loaded holding line and the unloaded closing line, it is necessary to provide more field weakening for the closing line motor to obtain the dash characteristic curve shown. Since it may sometimes be necessary to lower a loaded bucket, a reverse-current

relay must be included to reduce the closing line motor field weakening. The full-speed lowering characteristic will then be the same for both motions and the loaded bucket will be lowered with the weight divided between the two motors. For safety reasons — to prevent opening the bucket jaws and dumping the load in the event of circuit failure — the high-speed lowering contacts should be a spring-closed device.

The characteristic curves shown in Figure 10 are ideal for bucket operation with constant-potential control. For example, the armature shunt connection on the first two hoisting points provides a slow light-load speed for taking up slack cable and for the beginning of bucket-closing operation, when excessive speed might keep the bucket from digging down into the pile to get a full load. However, the first hoisting point still provides sufficient stalled torque to keep the bucket from lowering when the operator is maneuvering to come up from under a hatch combing. In addition, the first lowering point provides a slow speed to permit landing the bucket carefully during clean-up operations.

Although these characteristics are quite desirable, those provided by a rotating regulator controlled adjustable-voltage drive are even better. As illustrated by the dot-dash line on Figure 10, an essentially constant torque can be provided during acceleration. On one particular installation, the torque limit was set at 150 per cent of the motor self-ventilated 1-hr rated torque. In order to obtain the same average rate of acceleration, torque peaks of 200 or 225 per cent would have been necessary on a constant-potential system. The division of load between the hold and close line motors when hoisting a loaded bucket on a constant-potential drive is dependent upon the skill of the operator and the slope of the characteristic curves. On a rotating-regulator drive, a load dividing circuit is provided so that the closing line will take a little more load than the holding line when both master switches are on the same hoisting point, thereby keeping the bucket jaws tightly closed. During acceleration in the lowering direction on a constant-potential installation, the closing line master switch must be moved slightly ahead of the holding line master, since the weight of the empty bucket will increase the accelerating rate of the holding line, and the bucket will tend to close if both masters are moved at the same time. Similarly, during deceleration, the holding line master must be moved back toward "Off" in advance of the closing line master. On a rotating-regulator installation, a speed-matching circuit can be provided in the lowering direction to accelerate and decelerate both motors at the same rate, as long as both master switches are moved simultaneously. If a loaded bucket is being lowered, the speed-matching circuit is automatically changed to a load dividing circuit in the full speed position of the masters in order to keep either one of the motors from taking too large a percentage of the total load. If the operator desires to close the bucket as it is being lowered into a narrow hatch opening, the speed-matching circuit can be interrupted by simply moving one master ahead of the other. The bucket can then be reopened in the same manner after it is in the hold. There is no selector switch to manipulate when the operator wants to open or close the bucket while it is in motion.

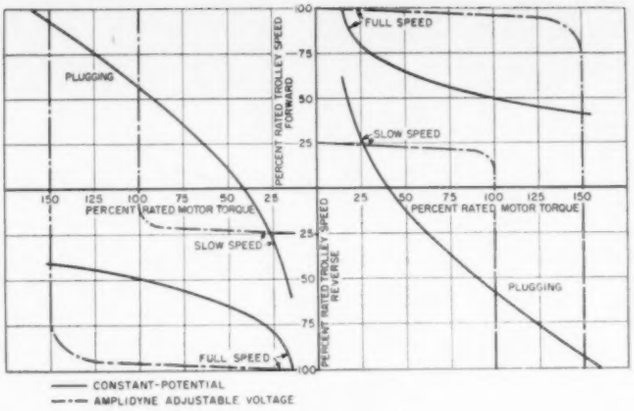


**Figure 11 — Typical trolley speed-torque characteristics.**

Figure 11 is simply another way of illustrating Mr. Blankenbeker's statement that an adjustable-voltage trolley will cover the average travel distance in a shorter time than a constant-potential trolley. Assuming that the motors of both types of drive are geared to provide the same rated trolley speed within the average distance, it will readily be appreciated that the constant accelerating torque of the rotating-regulator controlled installation will bring the trolley up to full speed in a shorter time than the gradually decreasing torque of the constant-potential characteristic.

Figure 11 also illustrates the difference in plugging performance of the two systems. If the trolley is running at full speed, the peak plugging torque obtained with constant-potential may be approximately 160 per cent of the motor 1-hour rated torque. However, the plugging torque and the rate of deceleration will decrease until the speed is slow enough to permit energizing the first resistor-shorting contactor. In comparison, the torque-limit adjustable-voltage control will bring the trolley to rest more rapidly at a constant rate of deceleration, and the torque can be less than the peak value obtained with a constant-potential drive. If the operator desires a slower rate of deceleration, he can plug on the slow speed instead of the full speed master switch position. As shown by this illustration, the ratio between the plugging torques on the slow speed and the full speed points can be made the same as the ratio between the coefficients of friction for wet and dry rails.

In discussing the selection of bucket and trolley motors for use on adjustable-voltage installations, Mr. Blankenbeker pointed out that rated motor speed and rated horsepower output of a shunt wound motor can be increased by applying more than rated voltage to the armature. He also stated that the thermal capacity of the motor would be increased by additional cooling at the higher average motor speed. Figure 12 illustrates that statement by showing the per cent of continuous rated current that a particular size of MDP-600 motor can carry at different percentages of rated speed. For example, if the average motor speed is 50 per cent of rated speed, the allowable RMS current over the complete cycle will be 84 per cent of the continuous rated current. In comparison, if the average motor speed is increased to 95 per cent by applying more than rated voltage to the armature, the allowable RMS current will be 98 per cent.

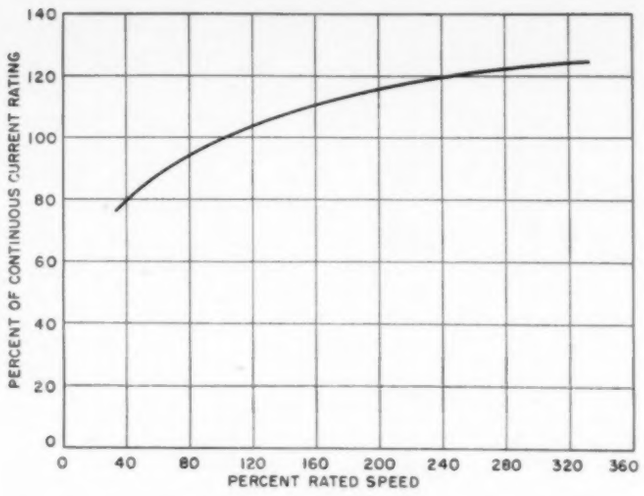


**Figure 12 — Continuous rating of self-ventilated MDP-600 series motor.**

The features mentioned in this discussion are not merely theoretical ideas — they have been verified on installations that are in regular service. When a new coal or ore bridge is contemplated, serious consideration should be given to the possibility of using adjustable-voltage for the bucket and trolley motions. In many instances, it has been found that the advantages of adjustable-voltage can be obtained at a lower overall installed cost than the alternate arrangement of providing a d-c substation along with a constant-potential bridge.

**E. J. Posselt:** Coal and ore bridges represent a large investment and therefore the proper selection of electrical equipment is very important toward receiving a fair return on that investment. Mr Blankenbeker is to be congratulated on his presentation which brought out some of the important points to be considered when electrical equipment is being decided upon.

According to the AISE standards on mill motor ratings, the forced ventilated continuous rating for 75 C rise is the same as the 1-hr totally enclosed rating. The forced ventilated continuous or 1-hr ratings are the same as the self ventilated ratings for the respective duty cycles. Therefore, Table I in Mr. Blankenbeker's paper showing the forced ventilated ratings should be on the basis of 1-hr and not continuous duty.

It was stated that the use of adjustable voltage control permitted certain reductions in motor frame sizes as compared to constant voltage control. A 3 ton saving was indicated with further savings in weight due to reduced weight of the control equipment. It appears that possibly all factors have not been included if a weight comparison is being made between an adjustable voltage and constant voltage system. An adjustable voltage system as discussed requires additional rotating equipment consisting of driving motor, generators, exciters and static or rotating type regulator sets. If all these items are included, this equipment may add more weight than that saved by the omission of contactors and resistors required for constant voltage control. In a paper presented before the AISE in 1944 by J. A. Jackson and M. A. Whiting (Proceedings AISE, 1945, p 144) on adjustable voltage drives for cranes, it was stated, a quick check indicated a 30 per cent increase in weight for an adjustable voltage drive over a constant voltage drive. Any appreciable increase in weight of the electrical equipment may logically require additional weight in the supporting structure with resulting increased costs.

If an adjustable voltage system is being contemplated, the location of the supporting generators and driving motor may present some problems. If they are mounted on the bridge structure it will then be necessary to feed motor shunt fields through collector rails which is not desirable. Rotating equipment requires floor space as it is not suitable to be stacked on shelves like resistor boxes. The number of collectors required will depend upon the location of generator units with respect to the motors they will serve and the location of the control panels and pilot devices.

Safety under emergency conditions as well as for normal operating conditions should be of prime importance with either type of control system. Brake failure or main power supply failure to the bridge may be the cause of an emergency condition. Most modern constant voltage bridge drives provide dynamic braking protection for these conditions on all hoist and travel motions. Dynamic braking is provided on all makes of dynamic lowering hoists. A self-excited dynamic braking circuit for trolley and bridge motions is strongly recommended as a good safety guard for equipment and personnel under emergency conditions.

On some installations standby losses may be an important factor when considering adjustable voltage equipment. On a hard worked bridge, standby losses may be negligible compared to one operating with long idle periods.

Adjustable voltage control will provide improved performance and some of the features that can be easily provided with this type of control may be very desirable for some installations. For general coal and ore bridge applications, the value of these advantages may be questionable if this type of control adds to the cost and complicates the equipment. The foregoing comments bring out some of the things to be considered when comparing one control system with another.

Mr. Blankenbeker stated a rapid accelerating rate on a trolley may result in discomfort or feeling of insecurity to the operator. If the control is designed and properly adjusted to provide smooth acceleration, the accelerating rate can be maintained at a relatively high level without discomfort. Sudden changes in the rate of acceleration produces discomfort and an illusion of excessive speed. This was demonstrated on a new installation on which the operator complained that the new trolley was not as fast as the trolley on an old rig. A simple test soon convinced this operator that the new trolley was faster than the old one and his reason for complaint was that the smooth acceleration on the new trolley gave him the feeling of running at slower speeds.

Factory assembled construction has been used on a number of bridge installations. The reasons for having control panels assembled and wired with the resistors at the factory are similar to those for many present-day mill installations. The control is completely assembled at the factory where the work can be done more efficiently than at the site of installation. It is tested as a unit before shipment which eliminates possibilities of errors in wiring. This all contributes to a high quality

final assembly at a minimum overall cost.

**P. R. Gravenstreter:** The business of making control to fit the application is most difficult in times like these and it is such papers as this one that give us much data and information. The reasons for importance of the paper are of a two-fold nature. Firstly, the ideas behind the application of the particular drive in question is analyzed in detail. Secondly, sufficient information is presented to enable accurate calculation of control components for the best engineered and co-ordinated drive.

Concepts of the application of control are changing rapidly at this time. Variable voltage is making itself evident, in all fields. It is now shown and is a matter of record that this system is not to be overlooked in the application of control to ore and coal bridges. Definite savings, when referred to installed costs today, when so many factors affect the costs which are most important should not be overlooked.

Overall duty cycles have become very severe, yet a savings in motor frame size is possible through the use of variable voltage drives, reducing weight, etc.

The paper deals in detail with the subject of trolley acceleration and deceleration. A few of us have had an opportunity to experience such rates of acceleration first-hand. It would be appreciated if Mr. Blankenbeker would give us an idea of the rates of acceleration and deceleration that are acceptable; in other words what is a fast and what is a slow rate. It would also be of interest to learn what limitations, if any, are placed on the rates of acceleration and deceleration by the operators of such machinery.

**J. E. Bodoh:** I am very happy to know that the author is advocating adjustable d-c voltage drives on bridges. I realize that time and space in a paper of this kind is quite limited; however, I believe that the advantages of this type of drive are so great that they should be further amplified in a general way.

In our everyday operation of bridges we fail to realize the enormous weight of the trolley that must be started and stopped, accelerated and decelerated many times during an eight-hour shift. The average trolley equipped with a 22½-ton bucket weighs approximately 140 tons. That is a lot of weight to move, just to handle 20 tons of ore. Every ton of weight added to the trolley means additional required strength to the supporting structure.

In addition to reducing the size of motors and brakes, adjustable voltage will eliminate the huge banks of resistors and the large number of control panels with all their necessary contactors, relays, and auxiliaries. This reduction in equipment will reduce the housing space required and the necessary electrical wiring.

All the above would reduce the weight of the trolley approximately 30 tons and the cost of the bridge considerably. The Ward-Leonard generator set could be reduced in size and weight by forced ventilation and high-speed operation.

Only three variable voltage generators and one exciter would be required if only the bucket closing, bucket holding, and trolley were operated on an adjustable d-c voltage. All other operations could be driven by a-c power.

The bridge drive may require wound rotor motors to provide variable speed to adjust for skew. The wound rotor motors would also eliminate overspeed when operating in the wind. All other operations such as rail clamps, apron hoist, turntable, and hopper gate could be squirrel cage motors.

The use of a-c motors would considerably reduce the control and wiring required.

**A. H. Myles:** I wish to compliment Mr. Blankenbeker on a very fine presentation of his paper covering the more general characteristics and operation of coal and ore bridges. His paper, along with others presented in recent years, provides for the manufacturers and users of such equipment a very valuable file on the subject.

I find the author's approach to the selection of motor frame size very interesting. It seems that each design engineer has a different way of calculating the motor size. Mr. Blankenbeker points out that the hoist motors are selected on their one-hour rating, the horsepower being based on speed and load. He also states that the ½-hour ratings are the maximum for use in calculating full load hoist speeds. These statements could perhaps stand some clarification.

For increased tonnage, the author suggests the use of shunt motors and adjustable voltage for operation at higher than normal motor speeds. Does this mean higher than normal bucket speed, and if not, how is greater tonnage obtained? Adjustable voltage, of course, also means a more complicated installation with a sacrifice of safety and reliability. It is also well known that response of shunt motors and shunt brakes with adjustable voltage is not as good as can be obtained with series motors and series brakes with constant voltage. This is particularly important in connection with the hoist motions.

In addition to slower motor response the use of smaller frame size motors with adjustable voltage means longer acceleration time due to less motor torque. Let us compare the times required to accelerate a loaded bucket with constant potential using 618 series motors and adjustable voltage using 614 shunt motors.

Let us assume a 15-ton load and a bucket weighing 33,500 lb. (Total weight W = 63,500 lb as given in Mr. Hays' paper presented May 13, 1949 at the AIEE Conference Committee on Material Handling.) Also assume that the two 614 motors are geared so that when fully loaded, a full load hoisting speed of 247 fpm is obtained with the motor running at 900 rpm at 425 volts, and that the 618 motors are geared so that when fully loaded the same hoisting speed is obtained at 380 rpm at 230 volts.

Using 618 series motors the data for calculation of acceleration time is as follows:

| | |
|---|---|
| Load per motor = 63,500/2 = | 31,750 lb |
| Full load motor speed = | 380 rpm |
| Full load hoisting speed = | 247 fpm |
| Full load motor torque = | 3,460 lb-ft |
| $WK^2$ of 618 motor = | 580 lb-ft$^2$ |
| $WK^2$ of 6000 lb-ft brake wheel = | 460 lb-ft$^2$ |
| $WK^2$ of drum, gears, etc. at motor = | 260 lb-ft$^2$ |
| $WK^2$ total of rotating parts = | 1,300 lb-ft$^2$ |

The equivalent $WK^2$ at each motor shaft for the loaded bucket is:

$$WK^2 = \frac{\text{total load}}{2} \times \frac{\text{hoist speed}^2}{(2\pi \times \text{rpm})^2}$$

$$= \frac{63{,}500}{2} \times \frac{(247)^2}{(2\pi \times 380)^2} = 340 \text{ lb-ft}^2$$

Total $WK^2 = 340 + 1300 = 1640$ lb-ft$^2$

Assuming 135 per cent average torque during acceleration and 100 per cent required to lift the load, we have:

Accelerating torque $= (1.35 \times 3460) - (1.00 \times 3460) =$ 1200 lb-ft

$$\text{Acceleration time } t = \frac{\text{total } WK^2 \times \text{rpm}}{308 \times \text{torque}}$$

$$= \frac{1640 \times 380}{308 \times 1200}$$

$$= 1.7 \text{ sec}$$

Using frame 614 motors the data for calculating acceleration time will be:

| | |
|---|---|
| Load per motor $= 63{,}500/2 =$ | 31,750 lb |
| Full load motor speed (at 425 volts) = | 900 rpm |
| Full load hoisting speed (at 425 volts) = | 247 fpm |
| Full load motor torque = | 1,460 lb-ft |
| $WK^2$ of 614 motor = | 209 lb-ft$^2$ |
| $WK^2$ of 3600 lb-ft brake wheel = | 190 lb-ft$^2$ |
| $WK^2$ of drum, gears, etc. at motor $= 260 \times \left(\frac{380}{900}\right)^2 =$ | 46 lb-ft$^2$ |
| $WK^2$ total of rotating parts = | 445 lb-ft$^2$ |

Equivalent $WK^2$ at each motor shaft for loaded bucket is:

$$WK^2 = \frac{63{,}500}{2} \times \frac{(247)^2}{(2\pi \times 900)^2} =$$ 61 lb-ft$^2$

Total $WK^2 = 445 + 61 =$ 506 lb-ft$^2$

If we again assume 135 per cent average torque during acceleration and 100 per cent torque required to lift the load we have:

Acceleration torque $= (1.35 \times 1460) - (1.00 \times 1460) =$ 512 lb-ft

$$\text{Acceleration time } t = \frac{506 \times 900}{308 \times 512} = 2.9 \text{ sec}$$

This is 170 per cent of the acceleration time required for the constant potential drive.

It might also be advisable to compare the energy to stop the two above applications, since the duty and maintenance on the motor brakes is closely related to the energy of the hoist system.

The equation for energy in ft-lb is given by the following:

$$\text{(Energy) } E = \frac{WK^2 \times \text{rpm}^2}{5872}$$

For the frame 618 series motor application using 6000 lb-ft brake:

$$E = \frac{1640 \times 380^2}{5872}$$

$$= 40{,}300 \text{ ft-lb}$$

For the frame 614 shunt motor application using 3600 lb-ft brake:

$$E = \frac{506 \times 900^2}{5872}$$

$$= 70{,}000 \text{ ft-lb}$$

We must, therefore, keep in mind that the 3600 lb-ft brake used with the adjustable voltage drive is subjected to 173 per cent of the braking requirements of the larger 6000 lb-ft brake.

On the trolley drive we have never considered the higher free running speed obtained with series motors a disadvantage. On long runs the higher speed can be desirable, but if considered too fast for proper stopping or safety, a permanent teaser field resistor is connected across the armature to limit the top free running or balanced speed. This connection gives speed-time acceleration and running characteristics approaching those shown by the author for adjustable voltage drives.

On bridge propelling drives, duplex control of series motors with two steps of armature shunt and skew protection has proven a quite satisfactory and simple installation. The use of shunt motors has always presented a problem of load division. We have, however, proposed shunt motors with adequate permanent series resistance to give a drooping load characteristic and thus allow for division of load. The author discusses the use of twelve shunt wound motors operating from adjustable voltage and in two groups of six motors each. I would like to ask what provision is made for division of load between the motors?

On constant potential bridges where the propelling drive is controlled from the operator's cab, maximum safety is provided by bringing the power feeding the bridge travel through disconnecting contactors in the cab. This arrangement provides the operator direct control against any fault which might occur such as grounded circuits. Including this safety feature, only eight trolley collectors (including the two main power lines) are required to provide independent control of the rail clamp and all motions of the bridge. To provide this same safety, I would like to ask how many trolley collectors must be provided when using adjustable voltage?

In discussing any control scheme we are concerned primarily with tons handled per hour. We know of no adjustable voltage bridges giving greater output than constant potential bridges of comparable size.

A check on a recent constant potential bridge type unloader using a 15-ton bucket shows an hourly free digging tonnage of better than 1600 tons. This means an average cycle of 33 seconds.

**E. L. Blankenbeker:** If I may judge from the comments made on the paper, the subject of coal and ore bridge electrical equipment is of definite interest to AISE members. It is difficult to cover completely all the component parts of a bridge electrical system in the time and space allowed for one paper. Perhaps future articles can develop individual drives and features in more detail.

An attempt will be made to reply to each discusser's comments where it is considered necessary.

Mr. F. Santiago questions the use of rotating regulators and suggests the regular Ward-Leonard system as a means of reducing the number of sliding contacts between the trolley and bridge. It is our understanding that the use of rotating regulators does not increase the

number of sliding contacts and that the rotating regulators are desirable particularly for their torque limiting feature. Bridge drive by adjustable voltage motors, regardless of the number of motors, has proven very satisfactory and has even been compared with fluid drive cars for smoothness of starting and stopping. Conductor rails are a maintenance item on any bridge. The use of special shaped extruded aluminum for this purpose has proven practical and its further use is recommended.

Mr. H. H. Angel's first question concerns cost comparison between constant voltage and adjustable voltage electrical equipment for a bridge when the power supply is available for the constant voltage equipment. No exact figures are available based on present day costs for duplicate tonnage ratings. Reference (3) in the Bibliography to this paper gives some cost data based on 1949 conditions. The following comparison is approximate and indicates the order of magnitude: adjustable voltage equipment installed would cost about 30 to 35 per cent more than rheostatic equipment. This would result in an overall cost of the bridge being from 4 to 7 per cent higher for the adjustable voltage scheme. A similar comparison based on a substation being required for both schemes and including the cost of runway feeders would show an advantage for the adjustable voltage scheme.

At present we have one bridge in operation and one under construction where the main motor generator set is mounted on the bridge span, and the rotating regulators are on the trolley. The collector troubles have not been excessive and what troubles we had were the result of newly designed equipment. Current collection is a problem on all bridges and is more critical for adjustable voltage bridges only because of the increased number. Considerable progress has been made in the use of aluminum conductors and metal graphite collector shoes. Further refinements in design and more service experience are expected to solve this problem. Closer co-operation between user, manufacturer and bridge builder will accelerate this or related developments.

Mr. Angel's third question concerned the selection of the trolley drive series motor speed corresponding to the desired top trolley speed. The writer always leans toward a value of motor speed 5 to 10 per cent below the value corresponding to the friction losses.

The writer is not aware of any bridges being built with roller bearing wheel journals.

Mr. S. Rifkin's comments and illustrations which more completely explained some of the points of the paper are very much appreciated.

Answers to Mr. C. G. Dimitt's questions are as follows:

1. The bridge drive motor location is much dirtier than on the trolley, also the intermittent nature of bridge drive offers no obstacle to use of enclosed motors. Many protected motors have been applied on trolleys. The writer has not heard of any difficulties due to their use. A history of this nature will have to come from the bridge users.
2. Both systems of forced ventilation have been used all without the use of intake filters. The common blower scheme requires objectionable air ducts on the trolley, but has the desirable feature of dynamic precipitation of some of the dirt from the air.
3. a. The end zone limit switches take control away from the operator if speed is excessive which might be considered "dead man" protection.
   b. Automatic slow down is contingent on trolley speed.
   c. There are some variations in the schemes. The preferred system provides for the slow down limit switches to take over the control if master switch is "Off" or on a position calling for power in the direction of travel, but if master switch is plugging the motors, then the limit switches are ineffective.
4. The writer does not have any further information on this question.
5. a. Two groups of two 65-hp motors could have been used. A proper answer to the question involves the relative advantages of the mechanical parts of the two schemes. Whereas one scheme has the advantage of the use of a few larger motors, it has the disadvantage of line shafting and extended flexible couplings. Either type can be made to work.
   b. That is correct, the hoist must be idle while moving the bridge.
   c. Manual speed points are provided for graduated slow-down during normal stopping. No graduated slow-down is provided during power failure stopping.
   d. No provision is made by the bridge builder for adequate braking when one of two brakes is out of service. This might be considered a small point in favor of more motors and brakes on each leg.
6. The two bridges, with which the writer is familiar, each have 12 conductor bars for feeding the trolley with all control located on the trolley.
7. A problem of this nature is in its first stages in the Baltimore area. The new adjustable voltage equipment will be fed by high voltage a-c conductors mounted above the existing d-c conductors.

In answer to Mr. E. J. Posselt's comments, the motor ratings given in the paper were taken from published catalog data and have not been questioned by any of the mill motor manufacturers.

Is it possible that the adjustable voltage crane referred to by Mr. Posselt was hauling the motor-generator set along with the trolley? The three ton saving mentioned in the paper is obtainable. Both types of bridge drives have their place and it was not the intention of the paper to endorse one type over the other for all applications.

Mr. J. E. Bodoh's suggestion of wound rotor motors for bridge drive is more practical if the bridge motion master switch is located on the bridge and not on the trolley. If bridge motion is to be controlled from the trolley with sliding contacts this would add considerably to the number of contacts required. The 30-ton estimated reduction in trolley weight by use of adjustable voltage appears to be optimistic.

In reply to Mr. A. H. Myles' discussion and the question regarding clarification of motor application: the hoisting horsepower is based on either the one-hour protected rating or the ½-hour enclosed rating which

are practically equal. This procedure has been recommended by a mill motor manufacturer and is included in AISE Standard Number 6.

Regarding increased tonnage by adjustable voltage drive, this means either higher bucket speed or a larger load and is possible with the same frame size of motor when it is operated at over-voltage, overspeed with the proper gear ratio.

Referring to his comments on accelerating times and brake duty, the comparison is on two motors and brakes with a ratio of two to one in nominal rating and cost and does not discredit the smaller motor too much in the writer's opinion. The 1.7 seconds accelerating time for the 618 motor does not appear to be enough to allow for five steps of accelerating relays and contactors to function to maintain the 35 per cent accelerating torque.

It would be possible to adjust the smaller motor's accelerating torque to about 60 per cent rating and obtain an accelerating time of 1.7 seconds without exceeding the peak values of the rheostatic control that would occur to maintain 35 per cent average accelerating torque. In most cases the frame size of the motor is only reduced by one instead of by two, as in Mr. Myles' example, when adjustable voltage is used.

The regenerative braking feature associated with adjustable voltage drives functions to relieve the motor brake of nearly all stopping duty. Rheostatic control has dynamic braking features for the same purpose. The times that the motor brakes are required to stop the lowering load from full speed are very infrequent. It would be of interest to evaluate the 70,000 ft-lb of energy dissipated infrequently by the 3600 lb-ft brake in terms of the brake thermal rating. Perhaps this amount of work is well within the capacity of the brake.

In answer to the question regarding twelve adjustable voltage bridge drive motors: a series resistance is used with each pair of two motors to provide the necessary droop in the speed load curve.

In answer to the question on number of trolley collectors used on adjustable voltage bridge, two duplicate adjustable voltages have twelve trolley collectors.

In conclusion, I would like to repeat that the paper was not intended to promote one type of bridge electrical equipment over another type, but instead to review the different types that have been built in recent years.


*Plan to Attend*

**1952 ANNUAL AISE CONVENTION**

**AND**

**IRON AND STEEL EXPOSITION**

**CLEVELAND PUBLIC AUDITORIUM**

**CLEVELAND, OHIO**

**SEPTEMBER 30, OCTOBER 1, 2 AND 3**

# AISE SPRING CONFERENCE

## CINCINNATI, OHIO

## APRIL 28-29, 1952

Despite an extremely unsettled condition in the steel industry, 752 members and guests attended the 1952 Spring Conference, sponsored by the Rolling Mill Committee of the Association of Iron and Steel Engineers, which was held in Cincinnati, Ohio, April 28 and 29. Registration (1) was held in the Netherland Plaza Hotel.

Participating in the various technical sessions on Monday, April 28, were: Wade Hoffman, Jones and Laughlin Steel Corp., T. M. Fairchild, Bethlehem Steel Co., and E. T. Peterson, Birdsboro Steel Foundry and Machine Co. (2); T. B. Montgomery, Allis-Chalmers Manufacturing Co., Roland Hess, Armco Steel Corp., and James D. O'Roark, Weirton Steel Co. (3); seated in (4) are G. D. Tranter and J. B. Whitlock of Armco Steel Corp., H. F. Jacquart, Jones and Laughlin Steel Corp., and standing J. J. Healy, Armco Steel Corp., and Harry Gilchrist, K. W. Atwater Engineering, Inc.

Monday evening, an informal dinner was held and an address was made by W. W. Sebald, president, Armco Steel Corp. Shown at the speaker's reception are Mr. Sebald and AISE president I. N. Tull of Republic Steel Corp. (5).

Tuesday morning, April 29, two additional technical sessions were conducted. J. N. Imel, Jones and Laughlin Steel Corp. (6) was a co-chairman at the rolling mill session. At this session J. J. Nolan, Bethlehem Steel Co. (7) read a paper on accident control for Carter Kendall. In the combustion session, held simultaneously, were seen (8) George H. Krapf, U. S. Steel Co., E. T. W. Bailey, Steel Co. of Canada, Ltd., who were co-chairmen, and J. L. Whitten, Lee Wilson Engineering Co., Inc., author of a paper entitled, "Single Stack High Convection Annealing for Narrow Steel Strip."

Seen around the conference were: J. P. Murray, Dingle-Clark Co., J. A. Bell, Bethlehem Steel Co., and W. M. Stillwell, Jr., Dingle-Clark Co. (9); seated in (10) are L. J. Gould, Bethlehem Steel Co., H. E. Davis, Republic Steel Corp., and M. Michel, Aluminum Co. of America, standing, C. C. Wales, National Tube division of U. S. Steel Co., and W. S. Hall, United Engineers and Constructors, Inc. A. E. Murton, Continental Foundry and Machine Co., right foreground in (11) shows a group of friends around the Continental suite. Holding a combustion session of their own (12) were: F. S. Bloom, Bloom Engineering Co., William Adler, National Alloy Steel Castings division, Blaw-Knox Co., E. J. Seabold and Horace Drever, both of Drever Co., and H. R. James, National Alloy Steel Castings division of Blaw-Knox Co. The "perennial" roll designers were also in attendance (13): F. H. Frey, Pittsburgh Rolls division, Blaw-Knox Co., Ross E. Beynon, U. S. Steel Co., H. W. Evans, Steel Co. of Canada, Ltd., and Louis Moses, Bethlehem Steel Co. In (14), W. E. Banner, U. S. Steel Co., S. P. Harris, Mesta Machine Co., R. E. Madden, U. S. Steel Co., and H. B. Brush, Societe Italiana Acciaerie Cornigliano, are discussing the new Fairless Works.

L. R. Brooks and C. R. Burrell, both of Tool Steel Gear and Pinion Co., located in Cincinnati, are shown (15) demonstrating the hospitality for which the gateway to the South is noted.

A. B. Russell, Sollac, recounts his experiences in the French steel industry to S. A. Swetonic, Lewis Foundry and Machine division, Blaw-Knox Co., and Edgar Herold, Crucible Steel Co. of America (16).

The inspection trip (17) to Armco Steel Corp. at Middletown, Ohio, brought to an end another successful spring conference.

## . . . . PICTORIAL REVIEW

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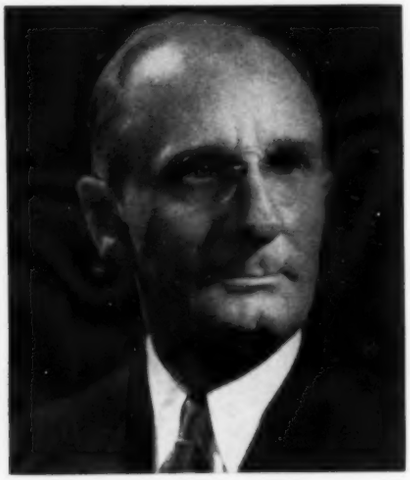
# Today's Challenge to Management

By W. W. SEBALD
President
Armco Steel Corp.
Middletown, Ohio



W. W. SEABALD

*. . . . from an address presented at dinner held in conjunction with AISE Annual Spring Conference, Cincinnati, Ohio, April 28, 1952 . . . .*

▲ IN the past, we in the steel industry were enveloped in a quite steamy atmosphere for a number of years. Now and then we were accused of profiteering and monopolistic and inflationary practices. We were charged with limiting production and of a general lack of interest in the public welfare. Gradually the atmosphere in which the steel industry lived began to clear. We did not hear so much criticism. In fact, we occasionally received a pat on the back.

Then came April 8th, and a man in Washington made an angry, biased speech about our industry. He deliberately tried to inflame public opinion against the steel companies. He attempted without success to justify his seizure of private property without due process of law. None of us ever expected to hear or see anything like this in America. All over the country people were stunned.

After this bitter attack, we should realize how fortunate we are that for several years past we have been telling the facts—real facts—to the public about this great industry of ours. This has brought about better understanding of our industry, its objectives, and what it has accomplished. In this case, understanding proved to be our strongest defender; it is our greatest hope of surviving similar attacks in the future.

This is all to the good. There is, however, another serious problem which has been developing for some time in our industry which I believe may make your job and mine much more difficult, if not almost impossible, to perform.

Management leadership is at stake. Bit by bit, present day labor leaders are attempting to undermine the confidence of employees in management. Day by day they are deliberately developing more and more of a cleavage between management and men. They are making promise after promise to influence men and are demanding the right to share in management.

Let us ask ourselves honestly why is management leadership being threatened? Why may union leaders take the initiative?

We could, of course, point to various reasons such as unsettled world conditions and the feeling of insecurity. However, one thing is certain; in recent years the business atmosphere has been favorable for union leaders to acquire more power. The labor leaders took full advantage of this opportunity, and they were aided and abetted by some of our vote-seeking politicians.

With such conditions prevailing, it seems to me that management also helped them along to more and more control by too often surrendering principle to expediency. Maybe management felt it was fighting a losing battle or perhaps it was willing to pay the price to keep the wheels turning.

On the surface it looks like we are getting along all right, but today we are living high in a mortgage economy. Anyone can live high for awhile if he can go to the bank and borrow a lot of money. Such shortsighted policy always catches up with us, and we as individuals and as a nation are now having that experience. We see the consequences in the lessening value of our dollar with prices chasing wages like a dog chasing its tail.

We may as well face it. This continuing spiral of inflation which has bitten deeper and deeper into all of our pocketbooks has not been blamed upon the spending politicians and the power-hungry labor leaders. It has been blamed upon industry.

The situation reminds one of a prize fight. The labor leaders are seconded and backed by vote-conscious administration politicians. These politicians sponge off their boy and advise him how to throw his punches. Management has no second in its corner giving help and encouragement. And there is no referee because the government is on the other side!

Unfortunately in every fight someone has to get hurt. In this case it is the innocent bystander—the public—who is getting it on the chin through higher prices and increased taxes.

Our labor leaders know full well that when wages go up costs and prices must go up, too. They know that

our standard of living cannot be raised further unless we have more production. They also know that if industry is to progress and create more jobs, it must earn a profit. They know that when the government spends vast amounts of money, taxes must be high, and inflation will eat away the purchasing power of the dollar.

Yes, most labor union leaders know these facts as well as you and I. Nevertheless, they ignore them and blithely mislead their members by telling them they are being imposed upon—they are not getting their share. The unions themselves are getting their share out of the pay of their members in union dues. The unions are in business, too—big business. They own real estate, banks, bonds and other investments.

They say honest confession is good for the soul. I believe one of the chief reasons management may lose its leadership is that too often we are too far from the people in our plants. Why is it that so many men in management jobs lose personal contact and the human touch with their people?

I think I know one reason: a lot of time is taken up in the offices, including mill offices, handling paper work, reviewing production records, studying cost reports, and what not. We are liable to forget that production and costs are not made in offices. They are made by the men in the plants and that is where we need to spend more time.

Is it not time that we do some grass roots thinking? Good human relations in industry are not the result of some magic formula. Most of us have seen new developments introduced in the personnel field such as wage rate plans, production incentives, profit sharing, and various other ideas. Each of these developments represents a forward step.

Maybe, however, we have depended too much on systems to maintain good relations instead of personal contact with people. Frequently we overlook the good old-fashioned virtues of rubbing elbows with the other fellow and showing a personal interest in his well-being.

Managements, of course, have the desire and the intention to deal fairly and aboveboard with the men and women in their organizations. Managements want the confidence of their people, but it cannot be gained merely with good intentions. Articles in the plant magazines and on the bulletin boards and newsletters are important and helpful in gaining confidence, but they do not substitute for personal contact.

We need to get away from the reports and paper work when we can and do deal with people patiently and sympathetically. We have to be good listeners, too, as well as good talkers so we can understand the other fellow's problems.

There is another point I think it is so important we keep in mind. Because union leaders stir up strife and encourage men to strike, slow down and the like, it is very easy to lose our patience and get mad. We should remember the majority of the members do not always believe in a lot of things their leaders advocate even though they are forced to go along with them. Most men do not want trouble, and the fact that a man is a union member does not change him as a man.

We do not have to be trained psychologists to make friends, if we keep in mind just a few facts that all of us know.

Every man is important to himself and he wants to be recognized as being important to his company. Every man craves recognition the same as you and I. He wants to feel his efforts are of value, and that his job is worthwhile, whether it's shoveling coal or managing a department. He would like to be proud of the company of which he is a part. Everybody wants to be somebody.

I think it is a safe statement to make that every person in your plant wants to talk about his problems and most everyone wants to gripe about something now and then. A steady flow of folks come to your personal relations people to talk about their worries, their opportunities, their bosses and what not. They come to your assistants to unburden themselves, and they would like to sit down and talk to their superintendent or whoever is the head man.

Just a few days ago a man came up to me in a newsstand and introduced himself. He was mighty proud of working for our company for 24 years. He wanted to talk about his job, and among other things he mentioned that he was nearing retirement age.

He said he had talked with his boss about retiring and the reply was, "Don't worry about that, Barney, for I need a man with brains to start that new blast furnace." This was recognition. Whose leadership will that man follow?

Recognition is a vital, compelling thing. Money is not the only force that stimulates and inspires people. Look what happens in amateur athletics. Men on your company basketball or baseball teams work harder by far without pay than they do on their jobs. Why? Recognition!

All around us we see the great interest men have in their jobs. When they get together downtown, the thing they usually talk about most is what is going on in the plant. Why, there is a great deal more steel rolled in conversation in the corner saloon and in meetings like you are having here than in our steel plants. And, of course, it is no secret that wives talk about their husbands' jobs and their husbands' bosses, just as your wife and mine.

When men believe that management wants to deal with them as people, have you not found they will respond to leadership and contribute with their minds as well as their hands? The seed from which management leadership springs is planted in men's breasts. The soil is there to be tilled, and if we till it we can be sure the tree of confidence and understanding will grow.

There is a lot of cultivating to do, and one plowing will not do the job. It is a day to day and year after year effort, and the hand of every management representative is needed.

Practically every man in this room has worked his way up through the plant. You are well known throughout the world for the great developments and contributions you have made to industrial progress. Our hats are off to you for these achievements.

Whether or not leadership in the steel industry remains in the hands of management is up to you. Hundreds of thousands of people look to you for the kind of leadership which only you can provide.

The larger our companies grow, the more of a problem it is to reflect top management's policies and intentions through the various rungs of supervision to the multitude of people required to operate a steel plant.

This needs to be done if leadership is to remain with management.

I say to the people in our company day after day that while we are not a small company, we must operate as though we were—and that applies to the officers of the company and everybody else.

All of us have a fertile field in which to work. I feel this because the inherent interest men have in their company is forcibly brought home to me from time to time in connection with our company's suggestion plan.

I make the major awards in my office to the man, with his family, his bosses and some of his fellow workers present. On these occasions we recognize the wife with an orchid, and the children with some spending money.

A recent award was for something over $2,000. This suggestion found use for a waste material which for many years had been thrown on the dump. When I presented the check, the winner said he was glad to have the money, but what particularly interested me was that he also said, "Isn't it too bad the company has been losing all that money for so many years?"

Another incident illustrating employee interest happened on the eve of the 1949 national steel strike. The CIO had ordered all plants to be struck on a certain week-end. This meant practically the entire industry would be down. A number of our plants were not affected because our men preferred their own union.

A day or two before the national strike was to be effective, I was walking through our hot strip mill at Middletown. This mill was scheduled to go down that week-end for a major repair job. One of the men came up to me and started to talk about the impending strike, lamenting the fact that the rebuilding job was scheduled at that time. He said he wished it could be deferred. I asked him why, and he said he feared if the mill went down, people might get the impression our men were out on strike, too. Furthermore, he said he knew it was important to get certain tonnage rolled as quickly as possible. As soon as I left him I checked with the proper people and found the job could be postponed. So the mill was kept running. This man had pride in his company and felt he "belonged."

Another personal experience I would like to mention illustrates what can happen when men feel free to talk over their problems with management. In December I made one of my periodic visits to our plants and talked to the men on the subject of why an increase in steel wages was not in their interest. As I left the dinner table at one meeting, a man asked if he could see me the next morning. He said he wanted to talk about a situation in his department. The plant manager urged me to do so.

The next day this man told me he realized he was not following the normal procedure, but since I was there he wanted to tell me how the men in his department felt. He said they were unhappy and disturbed because they considered some new practices which had been established did not give them a fair shake.

I told him we would get into it promptly. After investigation we found we had made some mistakes, and they were corrected. These men could have stayed off their jobs or slowed down. Instead they felt at liberty to tell their story. They believed management would listen to their side.

In our company we recently had an experience which is quite contrary to this incident. A couple of years ago we built a small plant in another community. Everything seemed to be going along smoothly, and then a short time ago we received a notice from an international union claiming that it represented the men.

Upon investigation we found that proper leadership was not being provided by the local management—those who had day to day contact with the men. We found misunderstanding on the part of the men because they had not been kept informed. We found they did not have an opportunity to express themselves. We promptly corrected that situation. Finally an election was held and the majority of the men voted against representation by the international union.

Most of all our American workmen are as sound as a dollar—that is, the old dollar. They are good citizens and patriotic to the core. They are friendly and neighborly and want to be helpful.

I have faith that the majority of American workmen do not expect to have things handed to them on a silver platter. They know they must look out for their own welfare and security and that of their families. As proof, look at the billions of dollars of insurance they buy; and the millions of dollars in bonds and savings accounts. Consider the thousands upon thousands of people who are buying homes, apartments and farms. They are honestly interested in making the best and most secure living possible for their families.

When men in our plants have the same facts as you and I, they will be inclined to react as you and I. They will be looking out the same window at the same picture.

The feeling that the interests of labor and management are opposite, and not mutual, has been very costly to our country. We simply cannot have two or three parties in the driver's seat and ever arrive at the destination we hope to reach. We are bound to wreck the car.

The public welfare is bound to suffer from this policy of "To hell with the other fellow." On the other hand, everyone would gain if labor and management would work in the long range interest of the public and approach the problem with "Do unto others as you would have others do unto you."

Tremendous things could be done in this country if labor leaders would cooperate and work constructively in the interest of producing more instead of following the philosophy of more pay for less work. More and better homes could be built at far less cost. Then, a man would not have to spend such a large part of his life's income to pay off the mortgage. He would not have to pay for a Chevrolet the price that once would have bought a Cadillac—and maybe he would have two cars in the garage instead of one. Great strides would be taken in education, recreation and our standard of living would shoot upward more rapidly than ever before.

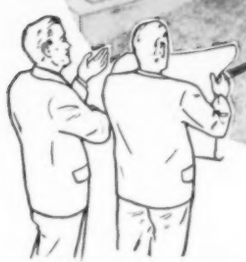
We have the know-how and the facilities to produce more at lower costs. How to provide the leadership to make this a reality is today's challenge to you and to me.

If Americans are to enjoy a more abundant life, then management must get behind the wheel of production and do the steering. How well we steer will depend upon how well we work with people.

"Rugged construction means durability"

"Control is fully automatic for utmost efficiency"

# NO WONDER THEY'RE ALL TALKING RUST SOAKING PITS



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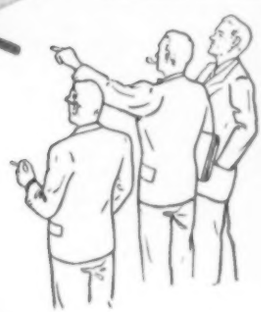
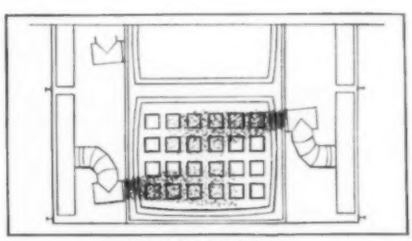
"Nothing like the Rust recuperator for economy"



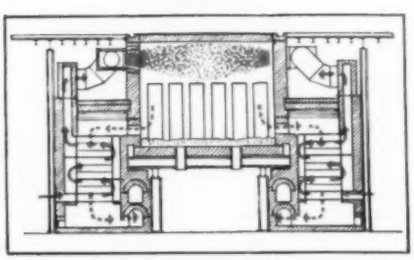
*New* CONTINUOUS 2-WAY TOP-FIRED

# RECUPERATIVE SOAKING PITS

## *raise the standard for outstanding results*



PLAN VIEW



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Naturally, furnace men are impressed with the improvements provided by Rust's new ultra modern recuperative soaking pits. Heat is uniformly balanced by diagonal two-way firing and ingots soak out evenly. Absence of impingement increases life of refractory walls and covers. Design permits construction in batteries of two or more holes, use of all fuels.

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One contract covers everything . . . from blue-print through start up. Rust assumes responsibility for design, manufacture, erection, and is prepared to undertake all phases of the work with its own forces, including wiring and piping. This results in substantial savings . . . One profit instead of pyramiding ones which accrue where many subs are employed.

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"STARTING LOAD ON OUR 40 H. P. CRUSHER MOTOR CAUSED 400 AMP. ORDINARY FUSES TO BLOW . . . BUT NOW 125 AMP. FUSETRON FUSES LET MOTOR START AND GIVE BURNOUT PROTECTION TOO."

## Mr. Meeka explains . . .

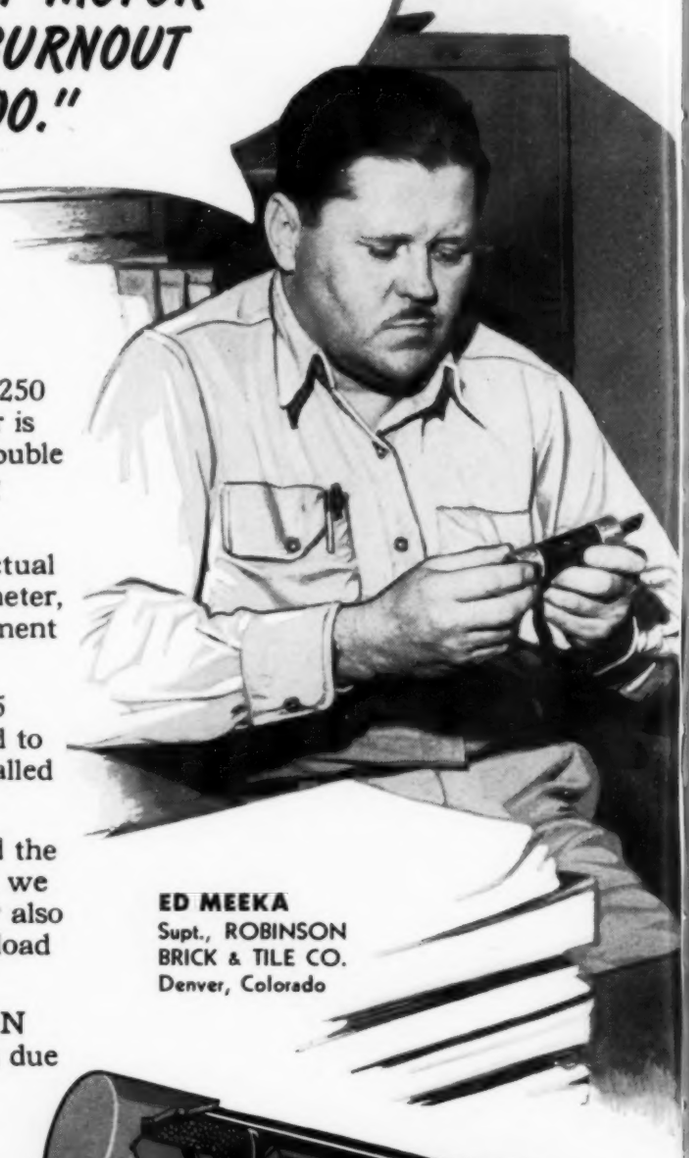
"We have a crusher driven by a 40 h.p. 250 volt motor. The starting load on this motor is often quite heavy and gave us no end of trouble by causing the 400 ampere fuses protecting the circuit to blow.

"Some months ago, after checking the actual running current of the motor with an ammeter, we decided to see if FUSETRON dual-element Fuses could live up to their claims.

"The ammeter reading indicated that 125 ampere FUSETRON Fuses should be used to give motor-running protection. So, we installed this size.

"Were we surprised—they not only hold the starting current of the crusher motor—but we have the satisfaction of knowing the motor also has burnout protection to back up the overload relays in case they should ever fail.

"Not once since we installed FUSETRON Fuses have we lost a moment's production due to a fuse blowing needlessly."



**ED MEEKA**
Supt., ROBINSON BRICK & TILE CO.
Denver, Colorado

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
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"FUSETRON FUSES NOT ONLY ELIMINATE USELESS SHUTDOWNS - THEY GIVE YOU 10 POINT PROTECTION."

1 Protect against short-circuits.*

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating—lesser resistance results in much cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

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7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels

10 Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

**DON'T RISK LOSSES**

One **needless** shutdown . . .
One **lost** motor . . .
One **destroyed** switch or panel
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

**MAIL THE COUPON NOW**
for complete information about the All-Purpose Protection of FUSETRON Dual-Element FUSES.

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Please send me complete facts about FUSETRON dual-element Fuses.

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*City & Zone*_____ *State*_____ 552

# STEEL MILL SHIPPED TO NORWAY

▲ As a result of the present modernization and expansion program in the steel industry, many of the older mills in good operating condition which might otherwise have become scrap have found useful applications and new life in other plants. This saving in equipment has been a result of the ingenuity and skill on the part of the used equipment dealer whose knowledge of the industry enables him to find a spot where the equipment can be used to advantage, and to his technique and skill in successfully removing the equipment from one plant to another. Many of these moves are long ones, and often are to foreign countries requiring the solution of many transportation problems and the utilization of rail, barge and ocean shipments.

**Figure 1 — The mill is shown shortly after dismantling work was started.**

An example of this kind of a move was the recent shipment of an 18 and 32-in. × 60-in., 3-high sheet breakdown mill which was moved from New Castle, Pa. to Bergen, Norway where it is being installed in the plant of the A/S Norsk-Blikvalseverk. This job was started on January 15, 1952 and the last shipment was completed by March 4. All work was handled by the Albert Curry & Co., Inc., dealers in steel plant equipment, who furnished all the riggers and millwrights required for the job. This concern has a key organization which can handle jobs of this type. The shipment included the mill units and an 80-ft pair heating furnace. One of the unusual features of this job was that over 30,000 refractory brick had to be cleaned and shipped along with the furnace. Entire shipment weighed 450 tons and required eleven cars.

This mill was in unusually good operating condition as it was installed shortly after the end of World War II, at which time it was completely rehabilitated, and set up to produce about 7000 tons a month. It was operated for one year by the Valley Manufacturing Co., for a motor car manufacturer at a time when sheets were extremely difficult to obtain.

As is common with such equipment, many special and difficult loading and handling problems had to be overcome. The largest unit which had to be shipped was a 40-ton double herringbone gear with an outside diameter of 15 ft 6 in., and 3-ft face. The heaviest piece was the 50-ton flywheel assembly which has an overall length of 20 ft and is 13 ft in diameter. Special railroad cars, routing

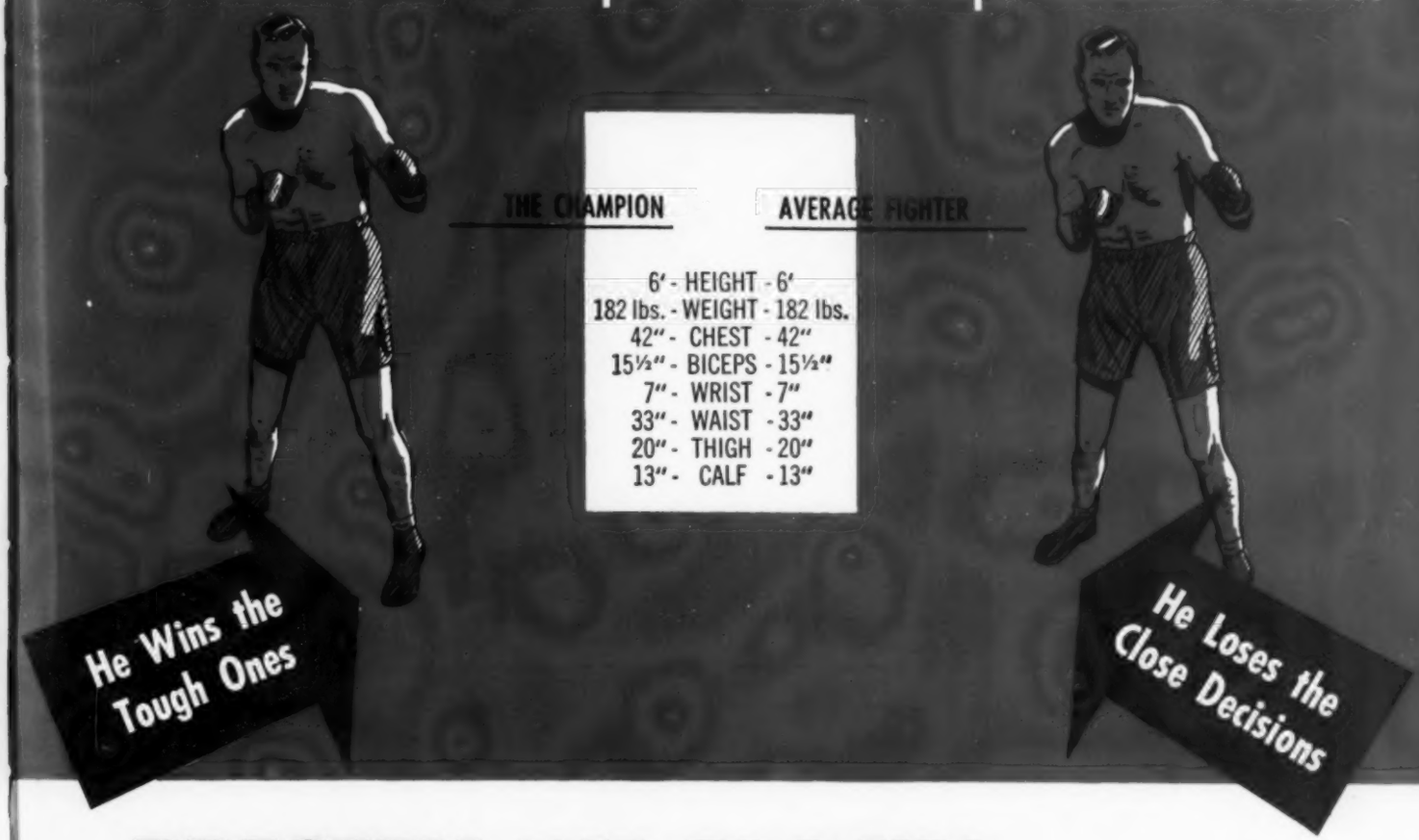
**Figure 2 — First stage in dismantling is shown in this illustration.**

**Figure 3 — Herringbone gear is shown prior to removal from the mill.**

**Figure 4 — Herringbone gear is shown loaded on special railroad car.**

# It's performance that counts

## There's more to a "Champion" than the tape measure shows!


He Wins the Tough Ones
THE CHAMPION
AVERAGE FIGHTER
6' - HEIGHT - 6'
182 lbs. - WEIGHT - 182 lbs.
42" - CHEST - 42"
15½" - BICEPS - 15½"
7" - WRIST - 7"
33" - WAIST - 33"
20" - THIGH - 20"
13" - CALF - 13"
He Loses the Close Decisions

# PRESTEM DIE BLOCKS...

## have the qualities of a "Champion" in the field of die steel.

This new steel analysis was developed and recently introduced by Heppenstall for the hot working of steels in forging presses and upsetters. It is available in the form of blocks and bars for solid press dies, insert dies, upsetter dies, and punches. It machines readily at high hardness . . . has high impact resistance . . . can be water cooled during press forging operations.

Prestem's record in large automotive forge shops proves the following benefits for production:

1. **Resistance to abrasion and wear at high temperatures.**
2. **Resistance to heat checking during long runs.**
3. **Increase in production per die.**

For complete information, address Heppenstall Company, Pittsburgh 1, Pa. Sales offices in principal cities.

**105,746 CONNECTING ROD CAPS were forged from this pair of PRESTEM dies. This is an INCREASE OF 130% over production obtained from standard Hot Work Die Steel.**

**Heppenstall**

*The most dependable name in die blocks*

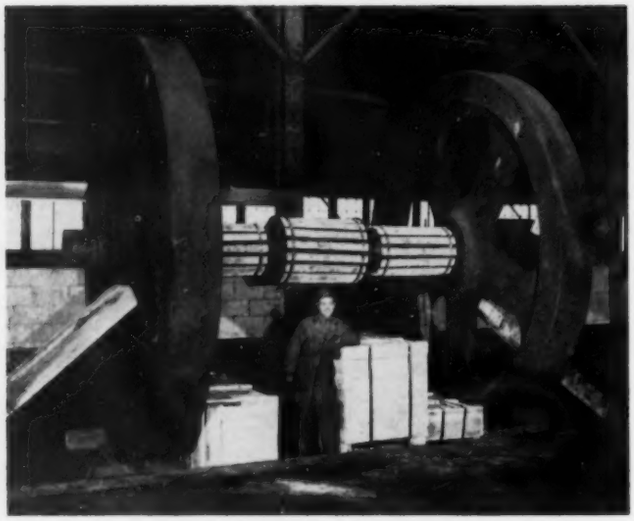


**Figure 5 — The 50-ton flywheel was one of the most difficult pieces to handle. It is shown on the railroad car.**

**Figure 6 — Skill is required in marking the various items of equipment so that they can be easily reassembled in the new location.**

and speed restrictions were used in the shipment. Special lighterage facilities were required to load these heavy units from the railroad to the cargo vessel. It is understood that the unloading problem from the ship and transfer to the mill in Norway presented some unusual problems, and are being handled by the Norwegian Co.

The main motor drive was not shipped inasmuch as only 50-cycle power is available in Norway. All small parts and tables were boxed for shipment. Another important requirement was that all items had to be completely rust proofed so that they would arrive in good condition. Skill is also required in marking the various items of equipment so that they can be easily reassembled in the new location.


HEAVIER CONSTRUCTION

another reason why
OHIO is the *PREMIER* mill magnet

In skull cracker service—or any use where magnets are subjected to hard knocks—you need the *extra heavy construction* of Ohio Magnets.

Take a look at this Ohio Basket Magnet, for instance. In addition to extra heavy top and bottom plates, hefty fenders project beyond magnet diameter . . . stave off and protect against damaging blows.

For extra magnet life, extra magnet value—specify Ohio Magnets. And remember, *Ohio Magnets lift as much or more than other magnets of the same size.* A-5388

THE OHIO ELECTRIC MFG. CO. • 5900 MAURICE AVENUE • CLEVELAND 4, OHIO

CHESTER BLAND
President

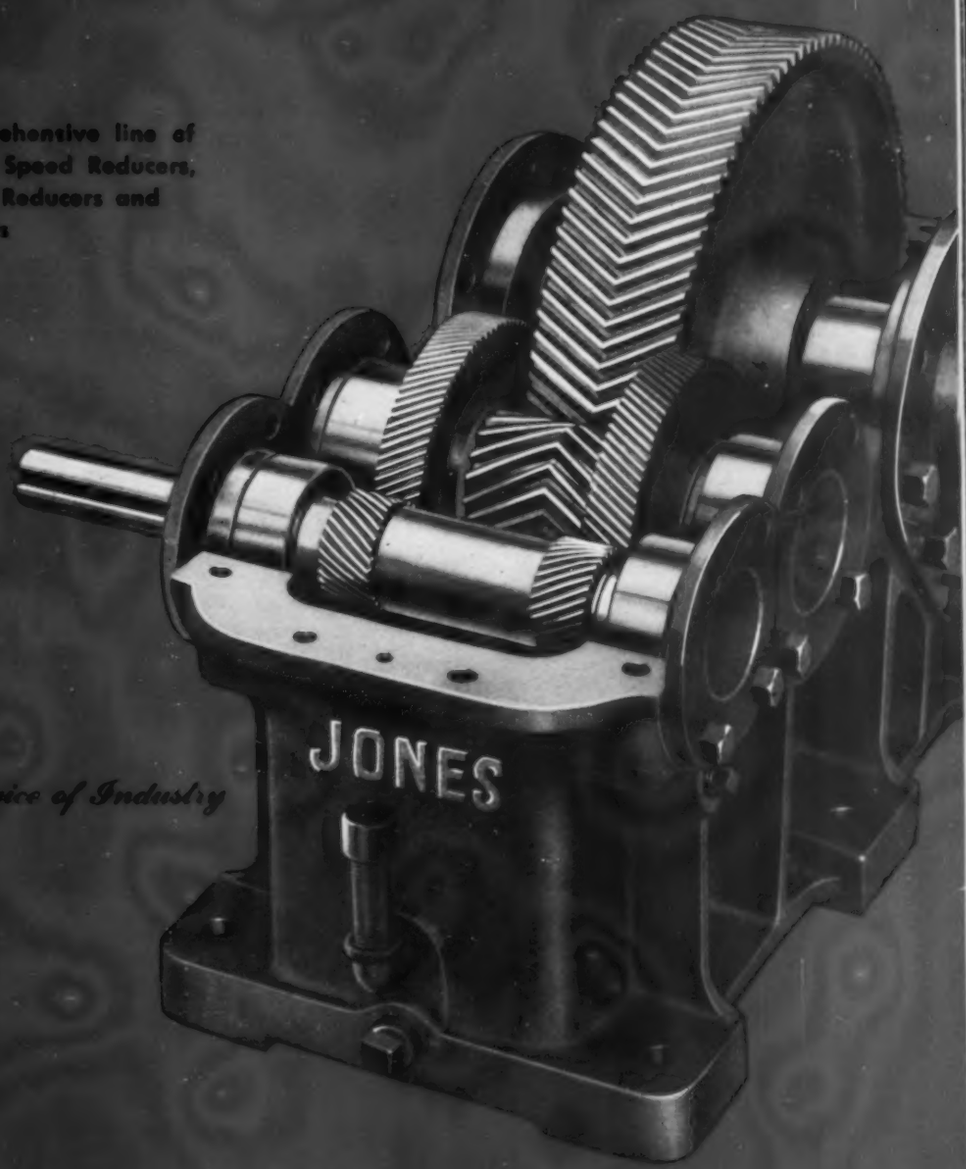
Ohio ELECTRIC

## MORE STANDARD SIZES TO CHOOSE FROM

In the range from 1 to 400 horsepower JONES offers the most complete line of Herringbone Gear Speed Reducers available *ANYWHERE*.

# Jones

**Manufacturers of a comprehensive line of quality Herringbone Gear Speed Reducers, Worm Helical Gear Speed Reducers and Worm Gear Speed Reducers**




*Since 1890... In the Service of Industry*

W. A. JONES FOUNDRY & MACHINE COMPANY, 4401 Roosevelt Road, Chicago 24, Illinois

# for MODERN ... the CONDULET* method gives YOU

A modern installation of Condulets and rigid conduit is always ready for quick change-over to meet the needs of today's fast moving industry . . . without sacrificing the vital qualities of PROTECTION to electrical conductors and SAFETY to personnel, equipment, and the plant.

Only Crouse-Hinds sturdy cast Feraloy Condulets and rigid conduit can give you ALL of these 8 definite advantages:

1. **FLEXIBILITY.** A modern CONDULET installation provides for growth and changing conditions. CONDULETS with detachable hub plates can be used to make it easy to change circuits or add new ones.

2. **MECHANICAL PROTECTION.** Crouse-Hinds sturdy cast Feraloy CONDULETS and rigid conduit provide the best possible protection against accidental damage to the wiring and equipment. Prevents costly shutdowns.

3. **CORROSION RESISTING.** Cast Feraloy CONDULETS give the best protection wherever moisture, dust, or corrosive atmospheres are present.

*CONDULETS are made only by CROUSE-HINDS*

Actual size photograph of a ¾-inch Obround Condulet. Sizes ½ to 6-inch A type for every purpose.

CONDULETS · TRAFFIC SIGNALS

# WIRING
## and rigid conduit
## 8 BIG advantages

Complete Installation of a Condulet and Rigid Conduit System in a Modern Metal Working Plant

**4 SAFETY.** Ground continuity is of vital importance. CONDULETS with taper threaded hubs and rigid conduit with tapered threads make a secure joint that provides a reliable and permanent low resistance path to ground. This safety feature assures maximum protection against personal injury and fire.

**5 UNIVERSAL APPLICATION.** You can install galvanized CONDULETS and galvanized rigid conduit under all atmospheric conditions and in all occupancies.

**6 ECONOMY.** The installed cost of Crouse-Hinds CONDULETS and rigid conduit compares favorably with other wiring methods. The added advantages make it the really economical method that pays dividends over the years.

**7 QUALITY.** The trademark CONDULET stands for the highest quality, reliability, and long life.

**8 VARIETY.** More than 15,000 items are listed in the CONDULET Catalog, including a complete explosion-proof and dust-tight line for use in hazardous locations.

FS Series Conduletes

GS Series Round Base Conduletes

RS Series Junction Conduletes Take Detachable Hub Plates

Form 8 Series Conduletes Have Large Bodies

*Arktite* Plug Receptacles

V Series Vaportight Lighting Fixtures

On YOUR next electrical layout, plan to get all the benefits of sturdy cast Feraloy CONDULETS and rigid conduit . . . the universal wiring method.

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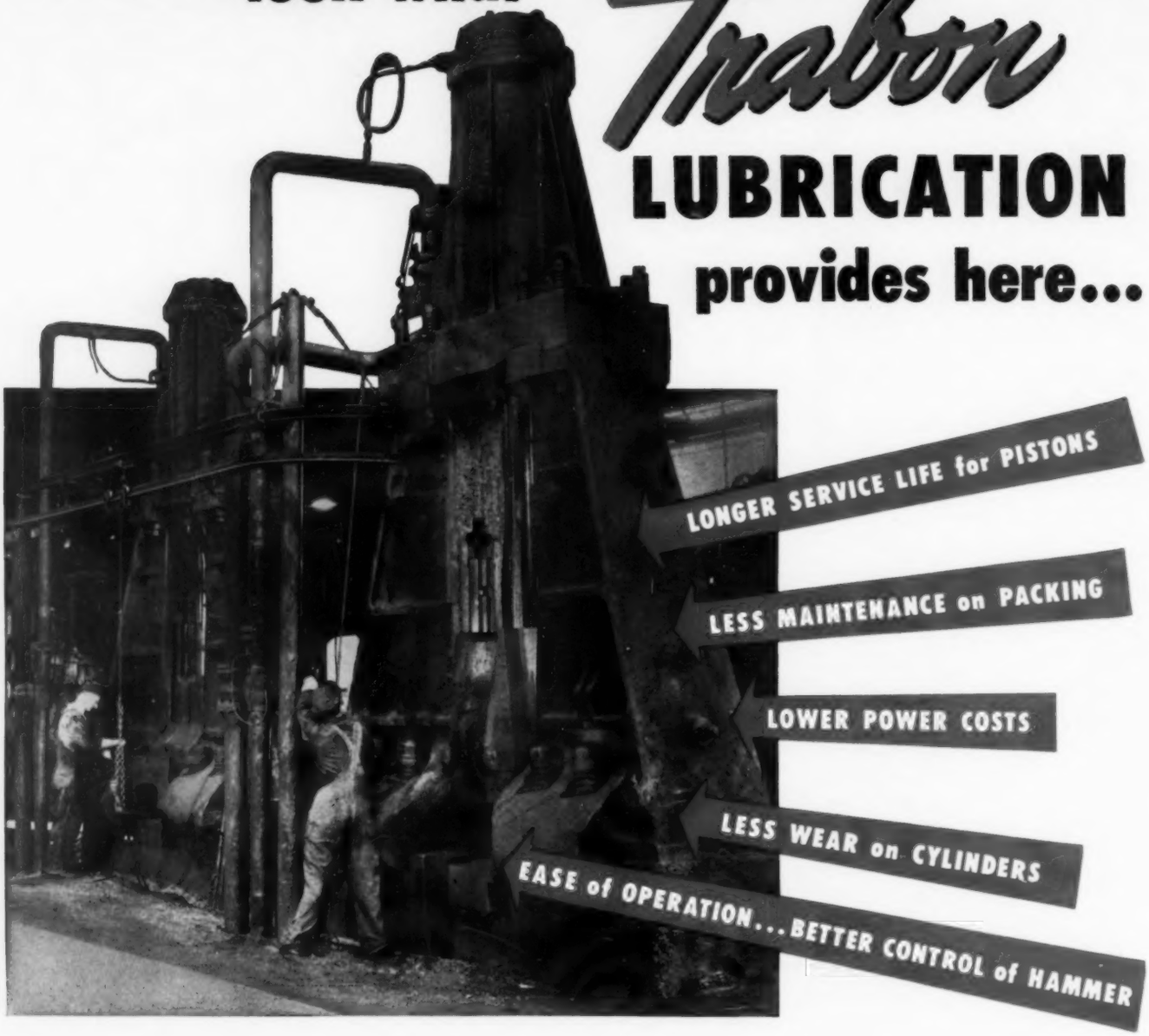
A Nationwide Distribution Through Electrical Wholesalers

AIRPORT LIGHTING · FLOODLIGHTS

look what *Trabon* LUBRICATION provides here...


LONGER SERVICE LIFE for PISTONS
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EASE of OPERATION... BETTER CONTROL of HAMMER

At Ohio Forge & Machine Corp. in Cleveland, giant steam hammers pound out production at a fast, steady rate of speed.

Here—as on all types of machines—Trabon assures lubrication that is vital to uninterrupted production . . . eliminating down time for repairs and maintenance.

Consult us about Trabon lubrication for your machines. We've been serving industry since 1922, engineering and selling lubrication.

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OIL AND GREASE SYSTEMS

**TRABON ENGINEERING CORPORATION**
**1814 East 40th Street • Cleveland 3, Ohio**

# Date-line Diary...

**April 2**

▲ British Iron and Steel Federation in its annual report states that it hopes imports of iron ore will "substantially exceed" the record level of 1951, following an agreement by the U. S. to reduce its demands on European supplies of the key raw material. Great Britain purchased 8,645,000 tons of foreign ore in 1951.

**April 3**

▲ The Labor and Commerce Dept. reported that construction outlays in March rose to $2,250,000,000, which was slightly more than March 1951.

**April 4**

▲ Donald M. White, secretary of the Aluminum Association, reports that 144,661,327 lb of primary aluminum were produced during February, which was slightly less than January.

▲ CIO president Murray announced notices would be sent out at once for a strike starting at 12:01 Wednesday after steel wage talks collapsed in New York between the CIO Steelworkers and six major steel companies. Acting Defense Mobilizer Steelman announced that the government would seize the steel companies in the event of a strike.

**April 6**

▲ The seventh blast furnace "Furnace J" has been lighted at Bethlehem Steel Co.'s Lackawanna plant. Constructed at a cost of $12,500,000, it is part of the $100,000,000 expansion program of Bethlehem Steel Co. Steel ingot capacity at Lackawanna will be increased 1,140,000 net tons this year.

▲ Republic Steel Corp. imported 167,262 tons of Liberian iron ore with a 68 per cent iron ore content in 1951. This helped Republic's raw material supply keep pace with its record breaking shipments of finished steel in 1951 amounting to 6,993,619 tons.

**April 7**

▲ NPA announced that all steel supplies on hand in mills and warehouses will be reserved for top priority military, atomic and machine tool programs, as a result of a nationwide steel strike set for midnight.

▲ Because of strike no production rate was announced for this week.

**April 8**

▲ Machine tool orders placed in the United States by foreign countries fell to $4,200,000 during February according to the National Machine Tool Builders Association. This is the smallest amount since the association started statistics in 1918. Machine tool shipments in February climbed to $82,000,000 or the highest monthly total in about ten years.

▲ The AAR reports that the nation's railroads had a net income of $50,000,000 in February compared with a $3,000,000 deficit in February 1951.

▲ British steel output in March was at an annual rate of 16,648,000 tons. Pig iron production jumped to an annual rate of 10,478,000 tons in March, the highest yet achieved.

▲ The AISI announced that steelmaking capacity at the beginning of the second quarter was estimated at 109,218,670 net tons. Scheduled additional capacity in the second quarter is 2,919,600 tons with 3,214,300 tons planned for the third quarter and 1,688,800 tons for the fourth quarter. Total increase for 1952 is scheduled at 8,453,700 tons.

**April 9**

▲ The ARCI reported that a total of 8159 new freight cars were delivered in March compared with 7358 in February. About 5619 new cars were ordered in March leaving a backlog on April 1 of 115,854 cars.

▲ Mystic Iron Works of Boston announced a price increase of $2.25 per ton for the second quarter, resulting in a price of $59.75 per ton for foundry and $60.25 for malleable iron.

▲ DPA's latest breakdown shows that the steel industry received 245 certificates of necessity permitting fast write-offs on $1,470,000,000 of the total $2,163,000,000 being spent on expanded steelmaking and rolling facilities. If blast furnaces, coke ovens, etc., are added the write-off figure is increased to $2,100,000,000. Steel firms received the largest block of accelerated write-offs of which about $14,579,000,000 worth have been issued.

▲ President Truman seized the steel industry effective early this morning.

**April 10**

▲ Judge Pine refused to set aside court rules to give the steel industry a quick hearing on their request for permanent injunction against the steel seizure.

**April 11**

▲ Jones & Laughlin Steel Corp. sold its twelve-story Pittsburgh office building to a group of organizations for slightly under $1,000,000.

**April 14**

▲ The freeze on construction of new television stations was lifted by the FCC.

▲ The AISI reports that the operating rate of the steel industry for the week beginning April 14th is scheduled at 97.0 per cent of capacity. This is equivalent to 2,015,000 tons of ingots and castings compared with 1,294,000 tons one week ago. The rate for last week beginning April 7th was 62.3 per cent of capacity. Low production was due to strike.

**April 15**

▲ The ICC authorized a 9 per cent hike in freight rates thus giving the railroads the full 15 per cent increase they requested one year ago. This rate increase will give eastern carriers an additional 6 per cent boost and southern and western carriers a 9 per cent boost to the 9 and 6 per cent allowed respectively last year. Exceptions to the general freight increase were that iron ore was raised 12 per cent, coal and coke 12 per cent subject to a 40¢ per ton maximum, and charges for handling iron ore on lake ports were raised 15 per cent. New rates will go into effect for most shipments on May 2nd.

**April 16**

▲ Erie Mining Co. of Aurora, Minn. received a certificate of necessity and accelerated write-off on 75 per cent of an estimated $298,070,000 for new taconite production facilities in Minnesota. This is the largest single certificate issued.

▲ Stockholders of Arthur G. McKee and Co. approved a two-for-one stock split.

**April 17**

▲ The Lake Carriers Association reported that ore carrying capacity of the U. S. lake fleet reached a record 3,033,050 gr tons during 1951.

**April 18**

▲ President Murray of the CIO called on the government to impose on the steel producers pay increases proposed by the Wage Stabilization Board.

▲ Republic Steel reported that their Warren district

blast furnace was shut down for a relining operation estimated to take two months. The capacity will also be increased to 1470 tons per day by increasing the diameter from 27 to 28 ft. This is a high top pressure unit.

**April 19**

▲ Armco Steel Corp. reported that it had shelved plans to spend between $45,000,000 and $50,000,000 on new construction because of the high taxes and the uncertainties arising from the wage price situation in the steel industry.

**April 21**

▲ Effective April 21st, NPA abolished its controls on the manufacture of rubber products today.

▲ F. W. Dodge Corp. reports that construction awards in the thirty-seven states east of the Rockies in March totaled $1,321,254,000, 49 per cent higher than February, and 4 per cent ahead of March in 1951.

▲ The AISI reports that the operating rate of the steel industry for the week beginning April 21st is scheduled at 100.4 per cent of capacity. This is equivalent to 2,085,000 tons compared with 2,038,000 tons actual production one week ago.

**April 23**

▲ American Smelting and Refinery announced that they are starting development work in Peru at a cost of $75,000,000 on what may be one of the largest copper mines in the world.

**April 24**

▲ Economic Stabilizer Putnam announced that the steel price increases averaging about $3.00 a ton were authorized by the government under the Capehart amendment. Price hikes under this, however, give no compensation for pay boost proposed by the Wage Stabilization Board.

**April 25**

▲ National Steel Corp. announced that it is preparing to call its existing $40,000,000 series of first collateral mortgage bonds maturing in 1965, and will issue a new series of 30-year first mortgage bonds to the amount of $55,000,000. Some of the proceeds will be used to retire the existing series and the remaining $15,000,000 will be added to working capital.

▲ The AISC reports that March shipments of fabricated structural steel totaled 271,085 tons, a 10 per cent increase over the previous month's 246,398 tons. Bookings for March totaled 222,624 tons, slightly off from February and 25 per cent under the same month for the previous year. Estimated backlog at the end of March totaled 2,500,946 tons.

**April 28**

▲ Based on reports from companies having 93 per cent of the capacity of the steel industry, the operating rate is scheduled at 100.6 per cent of capacity for the week beginning April 28th. This is equivalent to 2,090,000 tons of steel ingots and castings compared with actual production of 2,087,000 tons one week ago.

**April 29**

▲ Judge Pine in the U. S. District Court in Washington ruled that President Truman was without power to take over the steel industry, and must return them to the owners. President Murray of the CIO steelworkers immediately notified union members to leave their jobs at once.

▲ United Engineering & Foundry authorized a common stock split up in form of a common dividend giving stockholders two additional shares of $5.00 par common stock for each share held as of record date of May 9th.

**April 30**

▲ Price of lead dropped 1¢ to a level of 18¢ a lb and thus sells 1¢ under the ceiling price.

▲ The government asked the U. S. Court of Appeals to put the steel companies back under federal control.

▲ Allegheny Ludlum Steel Corp. reported sales for the first quarter of $52,751,596 and net earnings of $1,459,813 or 84¢ per share. Sales in the first quarter of 1951 totaled $57,917,747 with net earnings of $2,707,056 or $1.66 a share.

▲ Armco Steel Corp. reported net earnings of $8,014,633 for the first quarter or $1.54 per share. This compares with $10,443,240 or $2.09 a share for the first quarter of 1951. Total sales for the first quarter of 1952 were $139,893,380 compared with $132,692,673 for the first quarter of 1951.

▲ Bethlehem Steel Corp. reported that sales for the first quarter of 1952 rose to $466,000,000 from $426,000,000 in 1951. Net profits for the quarter were equivalent to $1.80 a share compared with $2.45 a share last year.

▲ Crucible Steel Corp. reported net income for the first quarter of $1,429,243 or $1.78 per share compared with $2,206,296 or an equivalent $3.09 a share for the first quarter of 1951.

▲ Granite City Steel reported net sales for the first quarter of $15,945,825 with a net income of $993,504. After preferred dividends this is equivalent to 65¢ per share. Net sales for the same quarter in 1951 totaled $20,807,409 and resulted in a net income of $1,431,385 or $1.07 a share of common stock.

▲ Inland Steel Corp. reported net sales for the first quarter of $123,652,436 compared with $132,206,038 in 1951. Net income totaled $6,936,470 or $1.42 a share compared with $1.90 a share the previous year.

▲ Jones & Laughlin Steel Corp. reported sales for the first quarter of $138,429,000 compared with $140,390,000 for the previous year. Net income totaled $4,711,000 or 70¢ a share compared with $1.18 a share the previous year.

▲ Kaiser Steel announced net earnings of $7,942,308 for the nine months ending March 31st compared with $5,539,731 for the same period a year ago. This is equivalent to $1.93 a share compared with $1.43 a share a year ago. Total sales were $87,839,884 compared with $72,443,542 for the previous corresponding nine months.

▲ Lukens Steel Corp. reported a net income for the first two quarters of its 1952 fiscal year ending April 19th at $1,623,603 or $5.11 a share compared with $6.32 for the corresponding period in the previous year. Total sales were $40,589,582 compared with $35,069,886 the previous year.

▲ National Steel Corp. reported net earnings for the quarter ending March 31st of $8,772,466 or $1.19 per share compared with $1.57 a share the previous year. Total sales were $24,857,081 compared with $41,901,440 the previous year.

▲ Sharon Steel Corp. reported total income for the first quarter of $39,854,414 compared with $43,219,667 the previous year. Net income after taxes totaled $1,370,802 or $1.25 a share compared with $2.30 the previous year.

▲ United States Steel Corp. reported income for the first quarter of $43,534,212 compared with $48,663,781 for the corresponding period in the previous year.

▲ Wheeling Steel Corp. reported March quarter sales fell over $7,000,000 to $51,067,553. Net income declined to $1.64 a share from $2.70 a share for the first quarter of 1951.

# The Men Behind "The Men Behind the Guns"

One of the most urgent necessities of our national security program is *steel castings built for combat* . . . castings that must stand up under shock, stress and unusual fatigue. The men at "Union" are working on a round-the-clock schedule to give the men behind the guns the utmost in protection as well as more powerful weapons for immediate use.

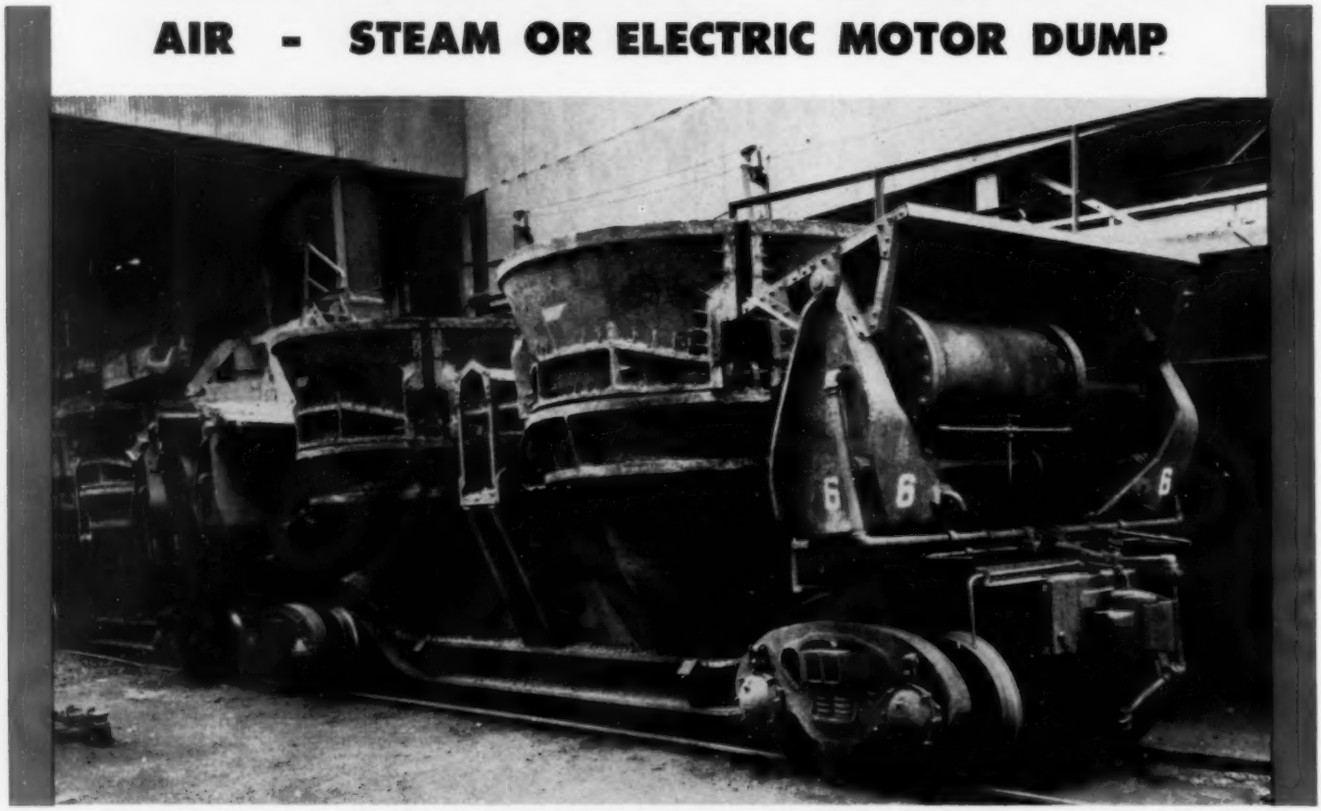
## UNION STEEL CASTINGS

DIVISION OF BLAW-KNOX COMPANY, PITTSBURGH, PA.

# TREADWELL

# CINDER CARS

**AIR - STEAM OR ELECTRIC MOTOR DUMP**



800 CUBIC FOOT TWIN POT CAR

## Increased Blast Furnace Capacity

*REQUIRES*

## Additional Cinder Handling Equipment

***TWIN POT CARS will enable you to HANDLE 20% MORE SLAG on the same track length***

**M. H. TREADWELL CO., INC.**

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# TNEMEC PRIMERS KILL RUST!

SMALL amounts of moisture will inevitably penetrate any paint film, causing rust and corrosion . . . but TNEMEC *uses* this moisture to destroy rust at its source!

TNEMEC PIGMENT is a compound which includes and intensifies the preservative properties of Portland cement. Combined with moisture, it creates a neutral condition on steel surfaces, changing active rust and corrosive agents into an inactive neutral compound.

That's the amazingly simple process that makes TNEMEC so outstandingly successful as a prime coat on steel. We invite you to investigate the performance of TNEMEC Primers on any type of installation . . . for adhesion, waterproofness and durability . . . under the most severe conditions. Its record as a long-lasting, anti-corrosive coating is unique.

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# Now you can have Burner Ports that keep their original contours

***These RAMTITE Burner Ports in an oil fired continuous heating furnace, after better than three years service, have lasted three times as long as the previous pre-fired Burner Blocks and still have perfect burner cone contour***

For maximum fuel and furnace efficiency the ports in a burner wall must be designed in exact accordance with the specifications of the burner manufacturer. otherwise there will be improper flame shape resulting in flame impingement and damage to refractories or to stock.

Why be so careful about burner cone design if they can't be kept correct? Pre-fired burner blocks frequently start to spall and crack soon after going into service. Ramtite won't.

Ramtite field men know the places where Ramtite can be used to best advantage, and how it should be installed. Why not let one of our men survey a troublesome furnace and give you his recommendations?

**THE RAMTITE CO.**
DIVISION OF THE S. OBERMAYER CO.
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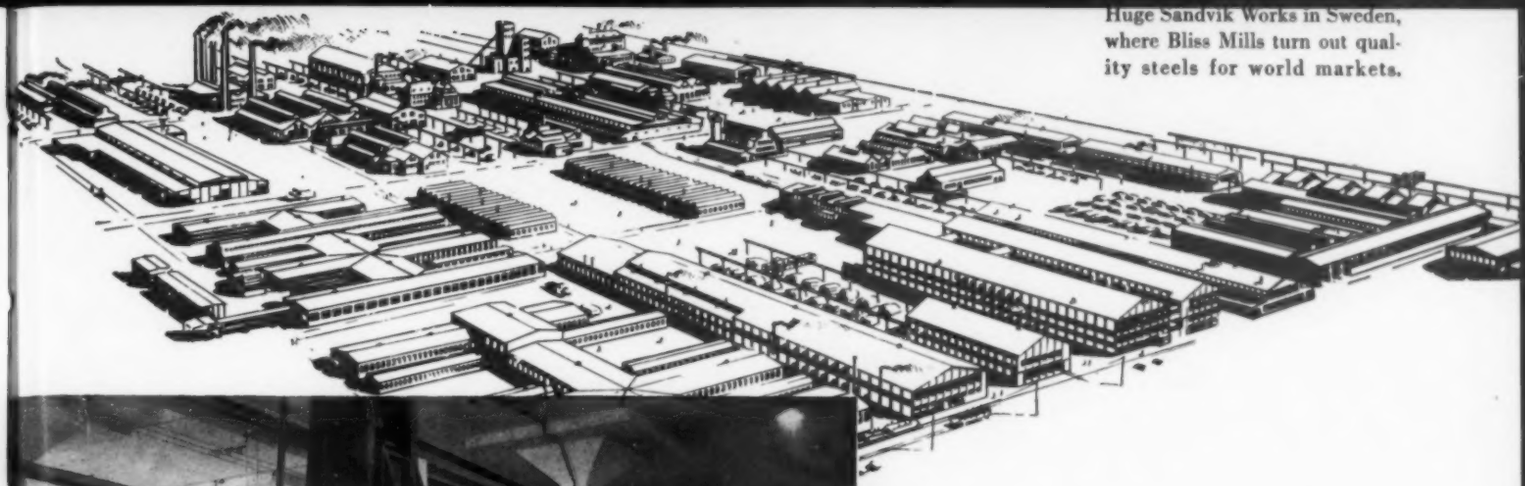
# RAMTITE

**PLASTIC AND CASTABLE REFRACTORIES**



Huge Sandvik Works in Sweden, where Bliss Mills turn out quality steels for world markets.

Four-stand cold reduction mill, designed and built by E. W. Bliss Company for Sandvik, produces high-carbon and stainless strip.

Bliss mandrel-coiler for Sandvik's 300 mm. hot strip mill.

# NEW BLISS MILLS PRODUCE MORE SPECIALTY STEELS FOR SANDVIK

When world-famous Sandvik Steel Works, Sandviken, Sweden, decided to increase production of its cold-rolled high carbon and stainless steels, it naturally turned to Bliss. Bliss' experience in designing strip mills is demonstrated daily at leading steel plants all over the world.

In creating a four-stand cold reduction mill Bliss supplied an installation with *capacity to spare*, fitted with the most advanced coil-handling equipment available. Thus *Bliss-engineered* improvements are helping Sandvik raise its already high standards for surface finish, flatness, straightness and accuracy of gage.

You find Bliss Rolling Mills and Accessories in leading ferrous and non-ferrous plants everywhere. They are effectively employed for breakdown, finishing and handling operations on solids, shapes, sheet, strip and foil. For details, write for your copy of our new 52-page brochure.

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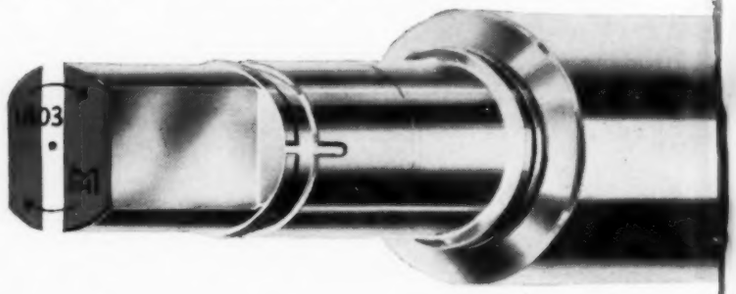
Remember:

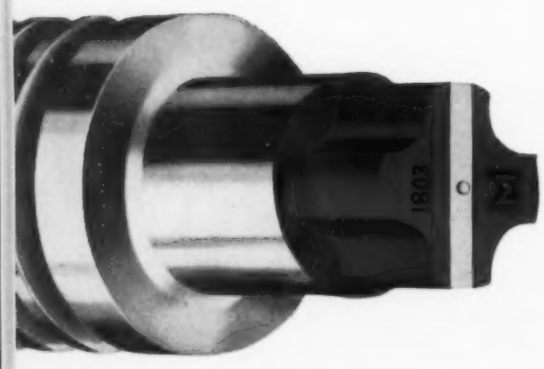
for Presses, ROLLING MILLS and Special Machinery... **It's Bliss!**

# Up-to-date as a...

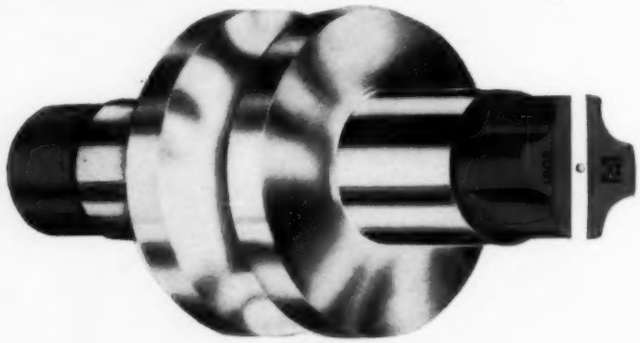
that's how Mack-Hemp's rolls with the *striped red wabblers* are—the latest thing in metallurgical developments and productioneering practice.



The skillful mill operators who make strip or pipe or wire or plate find that Mack-Hemp rolls are equal to the task, and then some.



Because Mack-Hemp keeps pace with modern trends in rolling mill practice, it's important for you to keep your eye on what's new and different at Mack-Hemp.



**MACKINTOSH-HEMPHILL**
**COMPANY**
*Makers of the Rolls with the Striped Red Wabblers*
**PITTSBURGH AND MIDLAND, PA.**

MACKINTOSH-HEMPHILL PRODUCTS INCLUDE: rolls . . . steel and special alloy castings . . . completely integrated strip mills . . . heavy duty engine lathes . . . Mackintosh-Hemphill rotary straighteners . . . improved Johnston patented corrugated cinder pots and slag-handling equipment . . . shape straighteners . . . end-thrust bearings . . . shears . . . levellers

# Industry News...

## HALF MILLION TONS ARE ADDED TO STEEL ROLLING CAPACITY OF FREE WORLD

▲ The steel rolling capacity of the free world was increased last week by almost half a million tons a year as a new steel slabbing and blooming mill in the Netherlands began operations. The new unit, first part of an expansion program being aided by U. S. financing, was completed and opened on April 1, the exact date scheduled for it when it was approved more than two years ago as a Marshall Plan project.

The increase in open hearth steel production capacity which will result when the program is fully completed, probably next year, will help to ease the short supply of steel products necessary for the rearmament effort of Western Europe.

The program involves the expansion and integration of the facilities of the Royal Dutch Blast Furnace and Steel Co. at Ijmuiden, The Netherlands, at a total cost estimated at the equivalent of $47,010,000. U. S. financing, through the Economic Cooperation Administration and its successor, the Mutual Security Agency, amounts to $23,500,000.

The completed mill, whose capacity is 490,000 tons a year, is the first section of a "production line" of steel mills being installed or expanded under the Royal Dutch company's program.

It will supply the plant's plate mill, whose annual capacity is being expanded from 140,000 to 205,000 tons and whose production will include thicker plates for The Netherlands' important shipbuilding industry.

The blooming and slabbing mill also will supply a new 56-in. semicontinuous hot strip mill which is a major item covered by the ECA-MSA financing. The hot mill, which will have a 245,000-ton capacity, including 60,000 tons of sheet, is expected to be in operation by September.

A cold mill, also financed with U. S. funds, is being added for additional production capacity of 75,000 tons of cold rolled sheet and 75,000 tons of tinplate. This will mean the Dutch will be almost independent of the United States for their tinplate supply. Their stated requirements of tinplate from the United States have been 20,000 tons quarterly, but they have been unable to obtain that amount.

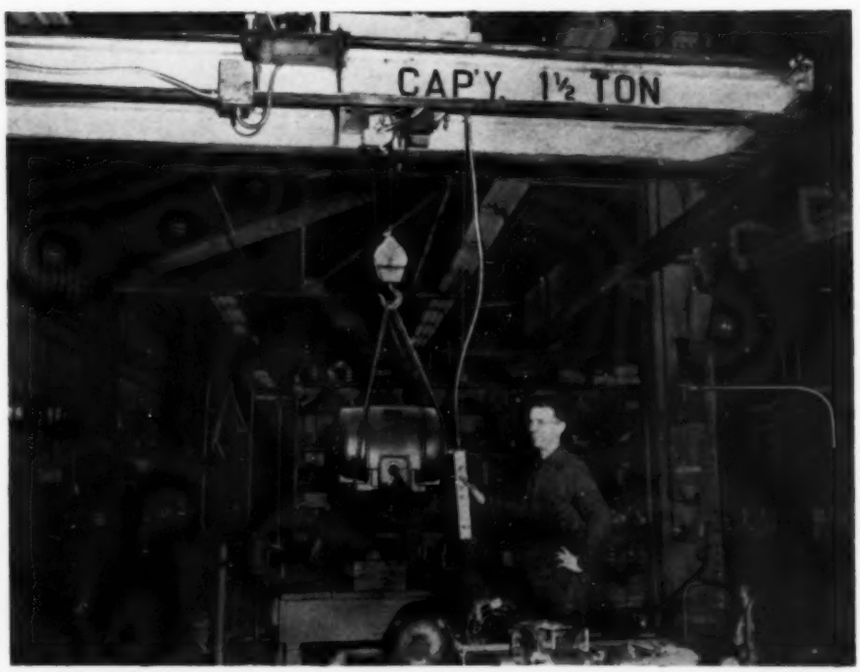
With the new plant, The Netherlands also will be less dependent on the U. S. steel industry for flat rolled steel products of other types. Imports from Belgium and France also will be reduced.

However, MSA officials pointed out, The Netherlands will continue to be a large importer of finished steel products. Her needs are especially high during the rearmament effort to which the nation is a solid contributor.

There are no plans at present, for instance, for production of alloys, stainless steel and other special steel products in The Netherlands.

The Royal Dutch firm is owned 25 per cent by The Netherlands Government, 15 per cent by the City of Amsterdam and 60 per cent by private shareholders. Equipment available in Europe has been financed by the Dutch interests. This includes the mechanical part of slabbing and blooming mill, which was purchased in Germany. Major items purchased for the project by the Dutch from U. S. firms, and financed by ECA-MSA, are as follows: From United Engineering and Foundry Co., Pittsburgh: a hot mill finishing train, a tandem cold mill and a temper pass mill, $5,012,161. From International General Electric Co., New York, N. Y.: electrical equipment, motors,

## ELECTRICAL REPAIR SHOP CRANE



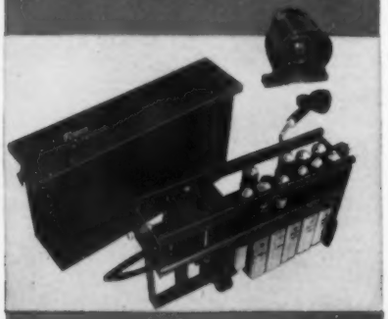

**This 1½-ton capacity crane, for use in the electrical repair shop of National Supply Co. plant at Ambridge, Pa., was built by employees of the shop, using salvaged materials almost exclusively. It is used in lifting motors, gear cases, and other objects too heavy for lifting by hand. Fully electrified, it is controlled from the floor.**

**The 80-ft crane runway consists of 6-in. H-beams formerly used in the machine shop when all lathes were run by motor overhead. The bridge was made of 8-in. I-beams and some 6-in. channels salvaged from a gas-producer no longer in use. The only new materials were a piece of steel about 20 ft long and 5 ft wide and end trucks 36 in. wide. Elmer Hall, foreman of electrical and crane maintenance, headed the project. The Ambridge plant, which manufactures seamless steel tubular products, is operated by the Spang-Chalfant Division of The National Supply Co.**

FOR MEN AT THE CONTROLS in Mills

Femco

TROLLEYPHONES GET THINGS DONE



NEW PLUG-IN MODEL
2550 Series

Years ahead in engineering and design! All parts plug in like tubes! Takes 30 seconds to replace spare parts! Cuts down time!

Wherever there are power rails or power lines, installations of Femco Trolleyphones can speed production, cut costs, promote safety and improve work conditions.

In better team work alone, Femco Trolleyphones pay for themselves. Consider—As many moving or stationary stations as are needed all brought in continuous contact with dispatchers and each other!

THE FEMCO TROLLEYPHONE IS ONE OF THE SIMPLEST, MOST USEFUL COMMUNICATION SYSTEMS EVER DEVISED.

*Demonstrations Arranged at No Charge*
*Write for Femco Bulletin No. 25*

*Let a Femco ENGINEER PROVIDE "YOUR VOICE OF ACTION"*

FARMERS ENGINEERING & MANUFACTURING COMPANY
549 Brushton Ave., Pittsburgh 21, Pennsylvania

spare parts, etc., including engineering design and drawings for slabbing and hot strip steel mill, $4,125,819. From Wean Engineering Co., Warren, Ohio: pickling, electrolytic cleaning line and shearing lines for steel mill, $1,611,748. From Continental Foundry and Machinery Co., Pittsburgh, Pa.: equipment engineering services, drawings for roughing mill for semi-continuous stripping, $1,157,600. From Aetna Standard Engineering Co., Pittsburgh, Pa.: various items of steel mill equipment and engineering services, $500,820.

## FORD MOTOR COMPLETES TUBE PROCESSING MILLS

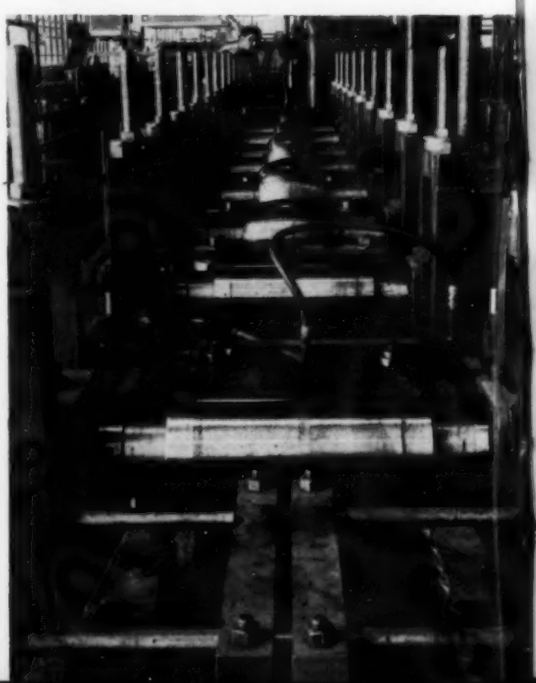
▲ After nearly three years of engineering research and planning, Ford Motor Co. has completed two of industry's most modern steel tube processing operations which are producing 180 ft of tubing a min.

Designed for quick conversion to defense production of welded tubing up to 5-in. diameter, the mills are located at the company's Mound Road plant, near Detroit, Mich.

One is nearly 400 ft long and turns out tubing for axle housings at a rate of 75 fpm. The other, 175 ft long, is producing 105 ft of tubing a min for driveshaft assemblies, a speed unequalled in industry on like quality steel.

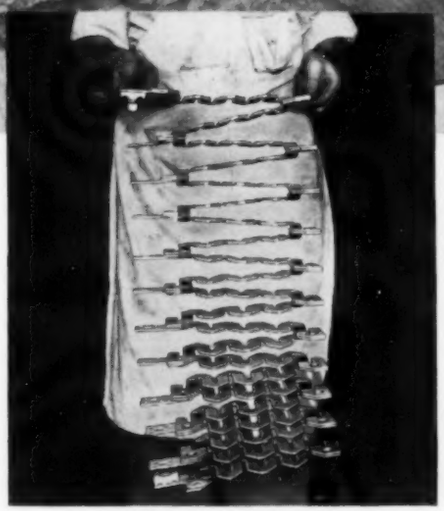
The manufacturing procedure of

**The rolls of this giant tube-mill machine pull and form coiled steel into housings for rear axles at Ford Motor Co.'s Mound Road plant. Two mills are in operation. They are designed for quick conversion to defense production.**



# Simplified TAP Shifting

1. When Improving Motor Operation
2. Making it Easier to replace Sections
TAB WELD
PLATE RESISTOR
THE ELECTRIC CONTROLLER & MFG. CO.



This illustration shows how welding provides a continuous path throughout each section to:

**1.** Stabilize the resistance value.

**2.** Eliminate trouble in concealed areas.

EC&M TAB-WELD Resistors do *not* depend upon *occasional* tightening of end-clamping nuts *to prevent burning at grid-eyes or at tap-plates.*

★ It's often advantageous to shift taps on a resistor section after installation to improve motor performance. It's equally advantageous, when replacing a section out in the mill, to pick a standard section from the storeroom shelf and use it *without disturbing the grid-assembly*.

These operations are easy to perform with EC&M TAB-WELD Resistor Sections because tap-plates are fixed in position. Only the terminal block, bolt, and lead are moved. The tap-marking tag moves with the bolt.

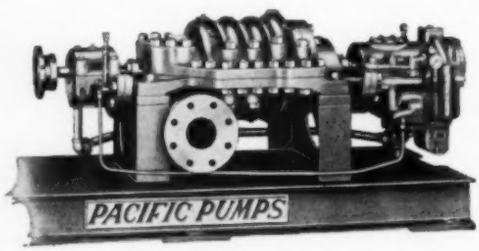
For lower up-keep, prolonged life, and easier maintenance, use EC&M Bulletin 942 TAB-WELD Plate Resistors, made from *corrosion-resistant* steel.

**THE ELECTRIC CONTROLLER & MFG. CO.**
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

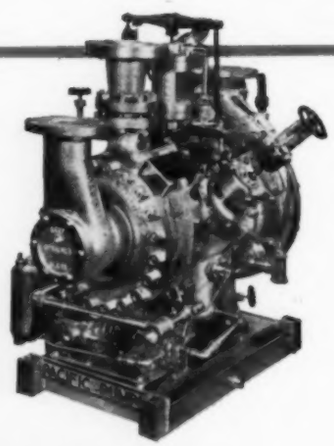
Specify
BOILER FEED PUMPS
by
Pacific
for small and medium sized
boiler plants

to insure
Reliability . . . Durability . . .
Resistance to Corrosion-Erosion
Dependable Performance and the
Highest Factor of Availability
at All Times

THE Pacific
MULTI STAGE TYPE JBF
Capacities To — 1000 GPM
Discharge Pressures To — 1000 psi
Electric Motor Drive To 3600 RPM
Steam Turbine Drive To 5000 RPM




THE Pacific
SINGLE STAGE-UNITIZED
STEAM TURBOPUMP
Capacities To — 500 GPM
Discharge Pressures to 1100 psi
STEAM To 900 psi Pressure — 850° F. TT
Exhaust Pressures To — 50 psi
Speeds To — 10,000 RPM



PACIFIC
Precision Built
PUMPS

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES
HUNTINGTON PARK, CALIFORNIA
Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities
BF-15

both mills is approximately the same and begins with the automatic unwinding of coiled steel from huge drums. Steel stock enters the loading end of the mill and is gradually formed into tubular shape by a series of parallel rollers.

The tube is then welded automatically and the flash removed.

Following this, the tube stock is cut to desired length by a process that virtually eliminates waste.

Tube stock then is moved automatically to annealing furnaces and transported to other manufacturing buildings to be processed into rear-axle and driveshaft assemblies.

The Mound Road operation represents Ford Motor Co.'s first tube mill production line since a small mill at the old Hamilton, Ohio, plant was discontinued in 1942.

## SMOKE ABATEMENT GETS STEEL MILL COOPERATION

▲ Since enactment of the Allegheny County smoke control ordinance in 1949, United States Steel Co. has carried out an extensive program of smoke abatement in cooperation with county authorities.

The company's program has included the addition of gas washers to clean blast furnace gas, construction of three sintering plants and a new boiler house, installation of modern stokers to insure proper combustion, and the purchase of diesel-powered equipment to replace coal burning plant locomotives and locomotive cranes. Mr. Hood also said the company's first diesel-powered tow boat, the "B. F. Fairless," is now in service and that two similar boats will be added to the company's river fleet this year. Four other coal burning tow boats have been equipped to reduce smoke.

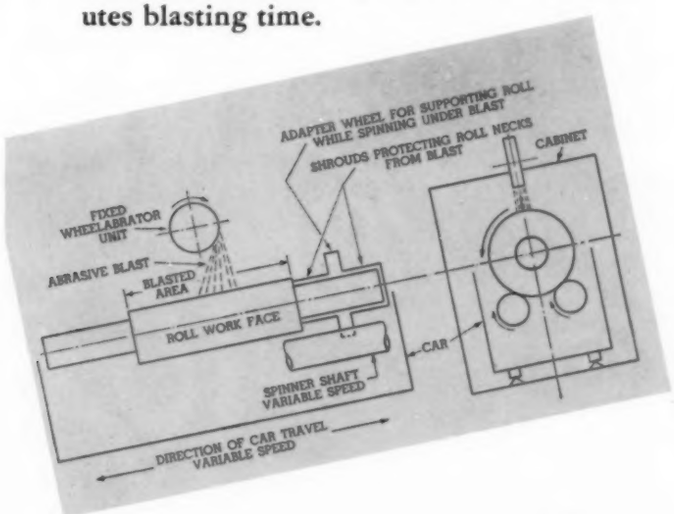
U. S. Steel — along with Jones & Laughlin Steel Corp. and Pittsburgh Coke & Chemical Co. — is participating in a research program to determine practical and economic methods for controlling the emission of smoke from three operations which are the most difficult to correct: blast furnaces, open hearth furnaces, and bessemer converters. A joint committee composed of members of the operating, engineering, and the research and technology departments of the three companies meets regularly and sub-

(*Please turn to page 146*)

# NEW SAVINGS for the steel industry

## Etching mill rolls with the Airless WHEELABRATOR®

The Wheelabrator opens new horizons in cost-savings possibilities for steel mills in the etching of mill rolls used in temper mills. In a typical installation at the Weirton Steel Company, 8 to 9 inch diameter rolls are etched in just 54 seconds blasting time. Large 26 and 27 inch diameter rolls used in the cold mill, are etched in 3 minutes blasting time.




*The diagram shows the airless Wheelabrator method of roll etching. This exclusive development conveys and rotates the work under a fixed and constant rectangular blast from the wheel.*

### PAYS FOR ITSELF THROUGH SAVINGS

Weirton previously roughened its temper mill rolls by passing emery paper between the rolls after installation in the mill. By eliminating use of emery paper for the initial etching of ground rolls, the Wheelabrator will more than pay for itself through savings in the cost of paper alone. Another big advantage is that it provides a better shape to the roll which means better gripping in the mill. Wheelabrating also provides an etch of a more uniform depth and texture which insures an improved surface on the steel sheet.

### AN IMPROVEMENT OVER AIRBLASTING

The Wheelabrator roughens mill rolls in 1 to 3 minutes that commonly takes from 10 to 30 minutes in conventional airblast machines. It produces a uniform etch automatically at a greatly reduced cost per roll. It is a proved fact that rolls so etched have a materially increased life in the mill with a resulting increase in tons rolled per set of rolls.

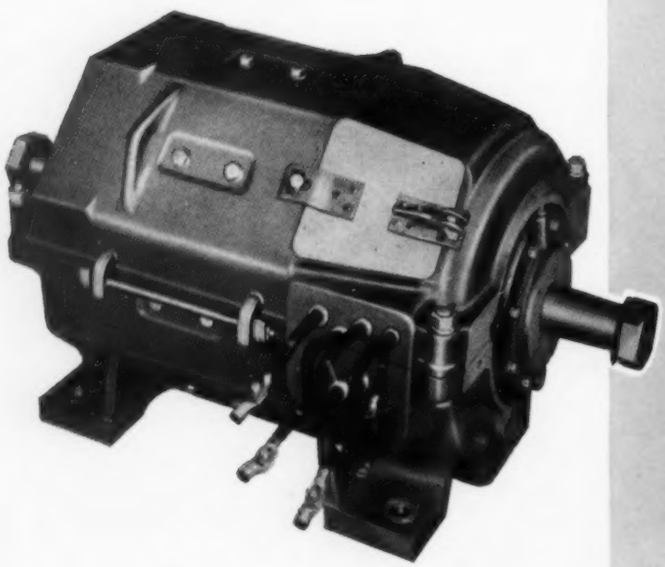
*Write today for complete information.*

**American Wheelabrator®**
AIRLESS BLAST CLEANING

**WHEELABRATOR & EQUIPMENT CORP.**
**396 S. Byrkit St., Mishawaka, Ind.**

**WORLD'S LARGEST BUILDERS OF AIRLESS BLAST EQUIPMENT**

D-3575



## Seven Basic Reasons

### WHY THIS MILL MOTOR WILL SET NEW STANDARDS OF PERFORMANCE IN YOUR PLANT

**1. BETTER COMMUTATION:** Brushes with ample current-carrying capacity—properly designed commutator—specially shaped commutating pole faces.

**2. UNIT ASSEMBLY OF FIELD COILS:** Formed coil is a solid mass completely insulated and protected from chafing or grounding . . . held firmly in place.

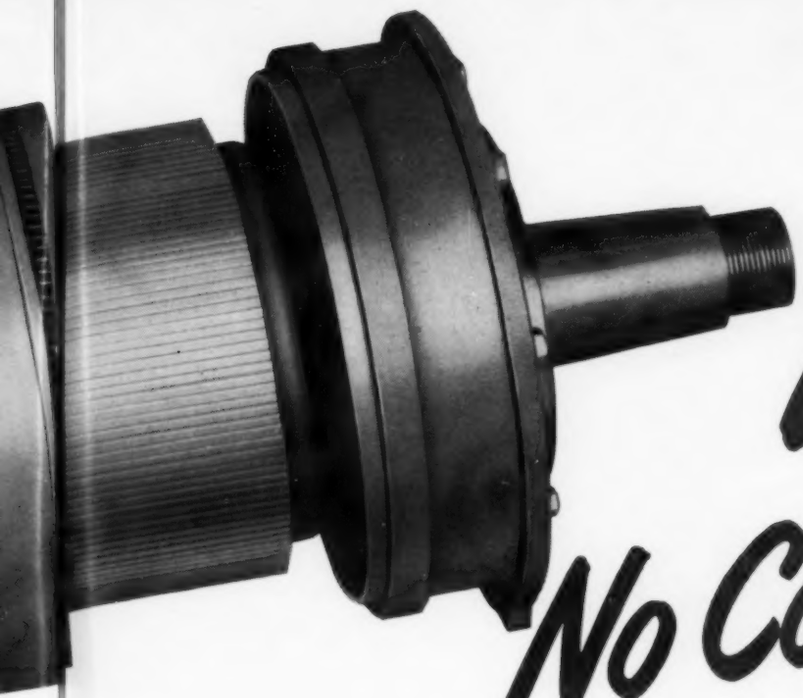
**3. HIGHER MAXIMUM SAFE SPEEDS:** Anchoring of armature coils with individual wedges permits safe operation at higher speeds—no core bands to come loose and cause trouble.

**4. HEAVIER AXLE STEEL SHAFT:** Larger in diameter between the bearings, on horsepower basis—made possible by mounting punchings directly on the shaft which is removable.

**5. RIGIDLY MOUNTED COMMUTATOR:** Bridge construction supports each end of commutator on shaft—no overhang.

**6. CAST-STEEL FAN:** One piece. Gives big fan performance, yet is no larger in diameter than core for easy armature removal.

**7. LOW-INERTIA ARMATURE:** Allows motor to start, stop and reverse with minimum stored energy.



# Look — No Core Bands!

## Wedges give you the toughest mill motor built

Wedges, instead of bands, hold the armature coils firmly in place on the new Westinghouse Series 600 Mill Motor. This means a stronger armature that is capable of safe operation at higher speeds . . . increased motor efficiency.

Broken core bands are destructive, also core bands can cause damage to the insulation on armature coils during assembly. Wedges eliminate this risk—make winding a simple operation. Each slot has its own individual wedge . . . made of Class B material. Simplifies servicing and repair work.

Further, complete insulation of the armature provides maximum electrical strength. Mica wrapper and glass tape protect the conductor. Complete armature assembly is impregnated with thermoset varnish. All this adds up to a rugged armature for a strong motor—built to handle your toughest jobs.

There are many more advantages offered by this mill motor that you will want to consider. Your Westinghouse representative has all the facts. Ask him for your copy of Booklet B-4730. Or write direct to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21663

YOU CAN BE SURE.. IF IT'S
Westinghouse

MILL MOTORS
AND CONTROLS

..and on
run-out tables,
too...
LOVEJOY L-R
FLEXIBLE COUPLINGS
last longer . . . . do the
job better!
THREE YEAR
MAINTENANCE-FREE
SERVICE RECORDS
"...three years of continuous operation of our run-out tables and not a single shut-down or break-down due to coupling failure". This statement is typical of the many made about the performance of Lovejoy Flexible Couplings. They have free-floating load cushions suspended between heavy metal jaws and cushions last two to five years. No shut-downs for changing cushions. These couplings instantly correct for mis-alignment without vibration, backlash or surge. No lubrication ever needed. For maintenance-free operation of your run-out tables and other equipment, use Lovejoy Flexible Couplings.
WRITE FOR COMPLETE CATALOG AND QUICK-FINDING SELECTOR CHARTS
LOVEJOY FLEXIBLE COUPLING CO.
5093 WEST LAKE STREET CHICAGO 44, ILLINOIS


(*Continued from page 142*)

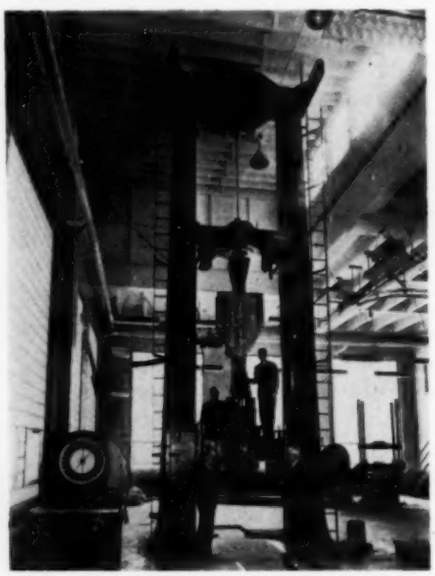
mits progress reports to the county's bureau of smoke control.

## PURDUE LABORATORY HAS HUGE TESTING MACHINE

▲ Central feature in the new structures laboratory at Purdue University is a new 600,000-lb Baldwin-Tate-Emery universal testing machine towering 30 ft in height. The floor of the building, 30-in. thick reinforced concrete with two imbedded 5 × 7-ft girders, makes a foundation that can be used for transverse tests of structural specimens up to 58 ft long (from wall to wall of the building). Anchors in the floor on 6-ft centers can hold a load of 100,000 lb either vertically or horizontally. Machine clearance for specimens is 22 ft vertically and 6 ft between columns.

The laboratory will be used mainly for research on structures of concrete, steel and other materials. Most of the work will be done by graduate students under the direction of faculty members. The testing machine has a number of special features that were provided for testing in these fields. The detailed specifications were the result of cooperative effort between Purdue's engineering department and Baldwin-Lima-Hamilton Corp. This is also the first machine of this capacity to have columns and base made as weldments instead of steel castings.

The Association of American Railroads is sponsor of two projects now in progress at Purdue in which the new machine will be used. They are (1) a study of static and fatigue strength in bridge hangers and joints,



# 2 names for quality assurance

**POLLOCK**
BUILDER FOR THE IRON AND STEEL INDUSTRY
*Since 1863*

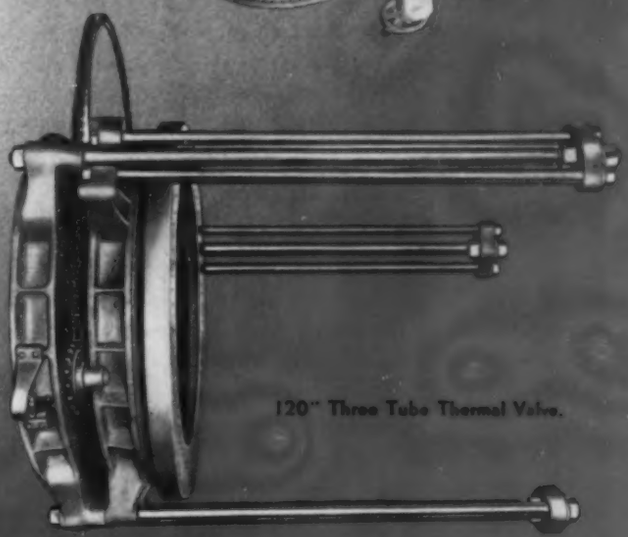
**Bailey ENGINEERS**
POLLOCK FABRICATES VALVES FOR WILLIAM M. BAILEY COMPANY

It's double assurance when an accepted leader in its particular field teams its engineering "know how" with the production "know how" of another leader in the field of precision construction.

For firms whose successful operations are assured by careful equipment selection, the Wm. M. Bailey Company of Pittsburgh is the preferred supplier of mechanical and thermal expansion valves.

Buyers of Bailey valves have an additional assurance when The William B. Pollock Company of Youngstown is entrusted with the precision production job.

Since 1863 Pollock has been the important **NAME** in the iron and steel industry for engineering, construction and erection of blast furnace and steel plant equipment throughout the entire world.



120" Three Tube Thermal Valve.

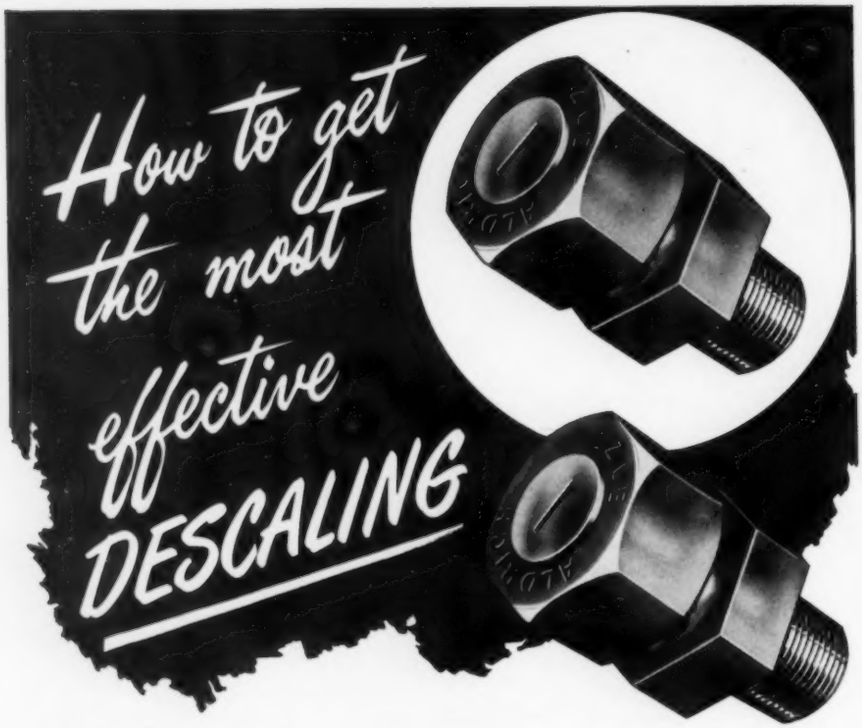
72" x 60" Hand-Operated Valve and Goggle Plate.

● The William B. Pollock Company fabricates to Bailey specification mechanical valves in the following sizes—54" x 42", 60" x 48", 66" x 54" and 72" x 60". These sizes are used mainly in the steel industry in blast furnace gas mains, gas washers, precipitators, boiler plants and coke plants, as well as chemical and metallurgical plants.

In addition, Pollock makes most Bailey Thermal Valves, from 60" x 48" to 120" x 104". These thermal valves are used mainly in the steel industry in the blast furnace plants—in gas mains, gas washers, etc.

**POLLOCK**
*Since 1863*
BLAST FURNACES • HOT METAL CARS AND LADLES
CINDER AND SLAG CARS • INGOT MOLD CARS
CHARGING BOX CARS • WELDED OPEN HEARTH LADLES

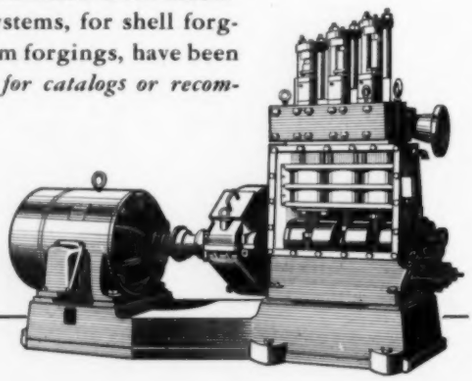
**THE WILLIAM B. POLLOCK COMPANY**
YOUNGSTOWN, OHIO
STEEL PLATE CONSTRUCTION • ENGINEERS
FABRICATORS • ERECTORS




Descaling is most effectively accomplished by means of the impinging force of a thin solid jet of water produced by high pressure. Scale is loosened in a fraction of a second by this force and by contraction due to cooling; it is then washed off by the deflected stream of water. The sharp, knife-edge of water and the solid striking force developed by *Aldrich Patented Spray Nozzles* give far more effective descaling than jets of equal force but with a larger impinging area, produced by more water at lower pressure—as proven in hot strip as well as billet descaling.

Several types of Aldrich Spray Nozzles are available from stock. *Write for Data Sheet 61-2.*

*Aldrich Direct Flow Pumps* used for descaling systems are fitted with automatic by-pass valves which operate with all types of accumulators. Both descaling cabinets and hydraulic systems, for shell forgings and other small to medium forgings, have been designed by Aldrich. *Write for catalogs or recommendations.*



THE ALDRICH PUMP COMPANY

21 PINE STREET, ALLENTOWN, PENNSYLVANIA

*. . . Originators of the Direct Flow Pump*

Representatives: Birmingham • Bolivar, N. Y. • Boston • Buffalo • Chicago • Cincinnati Cleveland • Denver • Detroit • Duluth • Houston • Jacksonville • Los Angeles • New York Omaha • Philadelphia • Pittsburgh • Portland, Ore. • Richmond, Va. • St. Louis • San Francisco Seattle • Spokane, Wash. • Syracuse • Tulsa • Export Dept.: 751 Drexel Building, Phila. 6, Pa.


both full scale and models, and (2) fatigue in 8 × 16-in. timbers on a 13-ft span.

The joints have gussets such as that illustrated which is 5 ft long and 3 ft wide. They are expected to fail at slightly under 600,000 lb. Small scale tests indicated that joints made up with high tensile strength bolts stressed up to their elastic limit through their clamping actions are more effective than riveted joints in resisting fatigue. Tests of full scale joints may verify this and throw light on the question.

Bonded on these joints and bolts are many Baldwin SR-4 resistance wire strain gages which will permit determining the distribution of stress and magnitude of strains, and perhaps may indicate the possibility of improvement in design.

## BLAST FURNACE BUILT IN 1904 STILL OPERATING

▲ A blast furnace moved from Alabama to India, across two oceans, during World War I, is still in production at Jamshedpur, India, according to American Iron and Steel Institute. Recently it was relined.

This blast furnace is probably the only one ever to produce iron on two continents on opposite sides of the world.

In 1904 the furnace, 85 ft high, was built at Battelle, Ala., about 40 miles from Chattanooga, Tenn. It could make 75,000 tons of pig iron a year.

The furnace had been inoperative for 11 years when the demand for steel rails in Mesopotamia during World War I influenced a steel company in India to buy it. It was dismantled in 1917, shipped by rail to New Orleans and put on a steamship. It was carried about 16,000 miles around the Cape of Good Hope through the Indian Ocean to Calcutta. From there it was taken 155 miles by rail to Jamshedpur.

Two years to the day from the start of its dismantling, the furnace was producing iron in India. It was reassembled by the same men who took it down in Alabama.

## J & L SUBSIDIARY GETS ORE EXPLORATORY OPTIONS

▲ In its search for possible new sources of iron ore, the Jalore Mining

"You mean a

# loose slot stick

stopped that

whole train?"

Certainly—but the report will say: "Motor failure was caused by a ground in the armature coil, 1 inch in from the end of the slot, pinion end." Overlooked in the report is the tiny slot stick, or wedge, which was made a couple of thousandths off size, or which was off a hair's breadth because of shrinkage. From it, coil vibration developed. Soon, a ground—motor failure—and *the train couldn't make the grade.* All over the world—in mines, in industry, in electric utilities—production trains can't make the grade because of "minor" failures deep in the bowels of motors and generators. National has demonstrated that the frequency of such "minor" failures can be drastically reduced. How? By insisting that every component which National supplies or installs must fit the particular job *that* motor or generator has to do—by refusing to be bound by standards set at some time in the obsolete past to fit general usage. We invite you to check the National record. We're proud of it.

*Wherever you are on nearby Field Engineer is available*

NATIONAL ELECTRIC COIL COMPANY

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—
REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

Co., Ltd., a subsidiary of the Jones & Laughlin Steel Corp., has acquired exploration options in four areas in Southeastern Ontario, Canada.

The ore company told landowners today that there was "indirect geophysical evidence of possible iron ore occurrence" in the district and that the four areas "merit more detailed examination." "However," the landowners were told, "we have no assurance that there is any iron ore on your property."

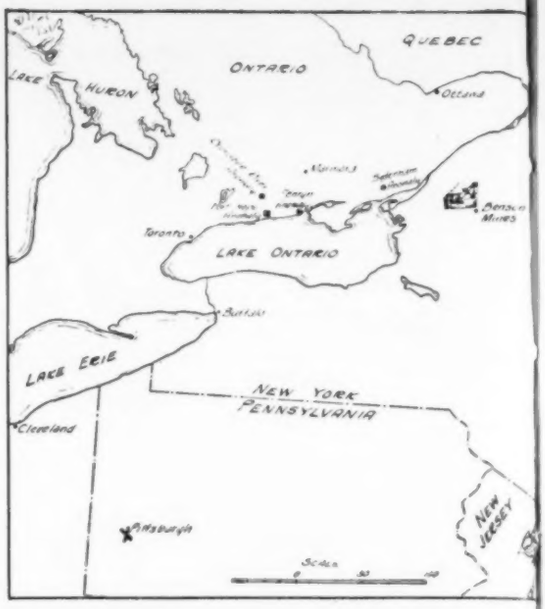
The options have been taken in the area on the north shore of Lake Ontario in Durham, Northumberland, and Frontenac Counties.

Three of the optioned areas are within 80 miles of Toronto, in the general vicinity of Petersborough, Ontario. The fourth property is southwest of Ottowa, in the vicinity of Kingston, Ontario.

Surface geophysical investigations will be carried out by J&L geologists this summer. Preliminary diamond drill exploration will be made in those areas where the geophysical investigations indicate that there may be promise of iron ore. The prospects are known only on the basis of geophysical "anomalies." The cause of these "anomalies" will not be known until further exploration by diamond drill is completed.

Field geologists of J&L's subsidiary company will be in the area within a few weeks, the landowners were informed.

If iron ore of acceptable grade and quantity is found on the properties, it will require deep-mine operations.




**Searching for new sources of iron ore, Jalore Mining Co., Ltd., has acquired exploration options in four areas along the north shore of Lake Ontario, as shown on this map. J&L operates an iron ore mine at Benson Mines in upper New York State, also shown on the map. Preliminary diamond drill exploration will be made in the Canadian area this summer.**

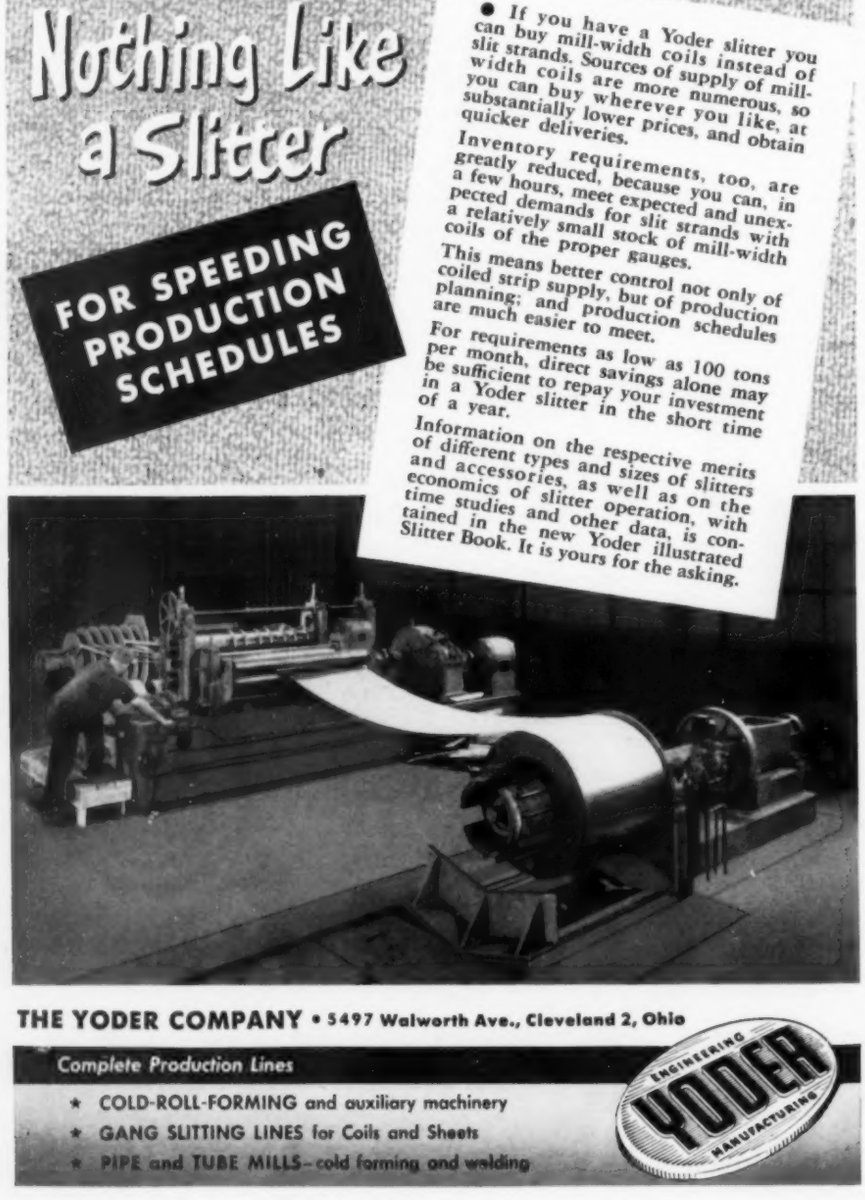
The corporation has no immediate plans other than to proceed with diamond drilling at this time.

## HYDROPRESS, INC., MOVES OFFICES IN NEW YORK

▲ The offices of Hydropress, Inc., 570 Lexington Avenue, New York, N. Y., and its rolling mill division, 139 East 56th Street, will be moved to the Empire State Building, 350 Fifth Avenue, New York, in June. The Loewy Construction Co., Inc., a wholly owned subsidiary of Hydropress, Inc., now at 216 East 49th Street, New York 17, will also move to the Empire State Building.

## BLOOM ANNOUNCES WEST COAST AGENT

▲ Bloom Engineering Co., Inc. of Pittsburgh, Pa., announces the appointment of Heat and Control, Inc. as its representative in the West Coast area. Heat and Control, Inc., which has headquarters at 285 Seventh Street in San Francisco, Calif., will handle Bloom's complete line of fuel burners and allied combustion equipment for steel mill and industrial furnaces.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FOR SPEEDING PRODUCTION SCHEDULES
● If you have a Yoder slitter you can buy mill-width coils instead of slit strands. Sources of supply of mill-width coils are more numerous, so you can buy wherever you like, at substantially lower prices, and obtain quicker deliveries.
Inventory requirements, too, are greatly reduced, because you can, in a few hours, meet expected and unexpected demands for slit strands with a relatively small stock of mill-width coils of the proper gauges.
This means better control not only of coiled strip supply, but of production planning; and production schedules are much easier to meet.
For requirements as low as 100 tons per month, direct savings alone may be sufficient to repay your investment in a Yoder slitter in the short time of a year.
Information on the respective merits of different types and sizes of slitters and accessories, as well as on the economics of slitter operation, with time studies and other data, is contained in the new Yoder illustrated Slitter Book. It is yours for the asking.
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★ GANG SLITTING LINES for Coils and Sheets
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## SINTERING MACHINE LAB DONATED TO ARMOUR

▲ A laboratory type sintering machine has been donated to Armour Research Foundation of Illinois Institute of Technology by Duncan Foundry and Machine Works, Alton, Ill.

Valued at $6600, the machine is a pilot plant model. It will be used for studies of lightweight aggregates for concrete and the treatment of finely divided ores.

Dr. Einar P. Flint, chairman of the foundation's ceramics and minerals research department, said the machine will be a valuable addition to present laboratory facilities. The foundation has been active in the development of improved concrete aggregates.

The American Ore Reclamation Co., Chicago, assisted in arrangements for the donation of the sintering machine.

## ELECTRIC METAL MAKERS TO MEET IN JUNE

▲ The twentieth annual meeting of the Electric Metal Makers Guild, Inc. will be held June 5, 6, 7, 1952 at French Lick Springs Hotel, French Lick, Ind.

The speaker for the joint technical session will be H. P. Rassbach, development engineer for the Electro Metallurgical Co. whose subject will be "Gases in Steel."

The annual banquet will be sponsored by the Electric Steel Castings Co. and the speaker will be Tom Collins whose subject will be "Mental Reconversion."

The presiding officers of the Guild are C. C. Spencer of the Electric Steel Castings Co., Indianapolis, Ind., president; J. H. Baldrey of the Allegheny Ludlum Steel Corp., Watervliet, N. Y., vice president; and C. B. Williams of the Massillon Steel Casting Co., Massillon, Ohio, secretary-treasurer.

## MIT TO DEDICATE ITS METAL PROCESSING LAB

▲ Plans for dedication of the new Metals Processing Laboratory at the Massachusetts Institute of Technology on Tuesday, June 3, have been announced. The dedication program will be followed on June 4 and 5 by a two-day technical conference on metal cutting which will feature speakers of national reputation in the metal cutting field.

Dedication exercises for the new building, made possible by a gift of $1,000,000 from Alfred P. Sloan, Jr., chairman of the board of General Motors Corp., will include a presentation address by Mr. Sloan and an address of acceptance by MIT president, Dr. James R. Killian, Jr.

## CASTING PROCESS FOR FRANKLIN, PA., PLANT

▲ Meehanite Metal Corp., New Rochelle, N. Y., has entered into a contract to install the Meehanite casting manufacturing processes at the Franklin, Pa., foundry of the Chicago Pneumatic Tool Co. The company will manufacture Meehanite castings largely for use in its own line of products.

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Use BUCKEYE Silica Firestone!
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Nature has endowed Buckeye Silica Firestone with every feature needed in modern refractory material. Its widespread efficiency, long life and attractive cost are well known to foundry and steel mill executives everywhere.
Under conditions where comparative tests have been made, Buckeye is first everytime! Its natural, uniformly-balanced combination of chemical and mechanical properties makes its superiority unquestioned. Its microscopically open and porous structure provides exceptional resistance to heat and abrasion.
Decide today to take advantage of Buckeye's many time-saving and money-making features. Write us at no obligation.
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## FIND RADIATION DETECTOR WITH WIDE RANGE

▲ A physicist at Armour Research Foundation of Illinois Institute of Technology has invented a wide-range radiation detector more versatile than any similar device now in use.

Leonard Reiffel, foundation nucleonics supervisor, is the inventor of the improved scientific instrument. It is expected that it will supplant many of the older, more complex detectors now used to indicate the strength of rays emitted by radium or other radioactive substances, as well as those emanating from atomic explosions and other chain reactions.

The outstanding feature of Reiffel's radiation detector is its simplicity of operation in measuring wide variations in radiation intensity. Previous detectors have required a switching arrangement to "tune in" the various radiation strengths.

Many such detectors have as many as three or four different ranges, and measuring various types and intensities of radioactivity is somewhat similar to switching a home radio from the regular broadcast band to an FM band, or one of the several shortwave ranges.

With the refined instrument developed by Reiffel and his group of nucleonics scientists, it is possible to detect rapidly — on a single scale — radiations which vary in strength all the way from one-tenth of a milliroentgen to 1000 roentgens. This is a sensitivity ratio of 10,000,000 to 1.

A roentgen is a unit for measuring the intensity of radioactivity.

As to Reiffel's technique for covering such a broad range of radiation levels on a single scale, the physicist pointed out that he is utilizing a method of automatically "desensitizing" the instrument as greater radiation intensities are encountered.

He compared the action of his detector in automatically desensitizing itself to an individual undergoing dental treatment who is given a hypodermic syringe filled with novocaine. At the slightest twinge of pain as a result of the dentist's activities, the patient may jab himself with another shot of novocaine.

Explaining the value of the single-scale, wide range detector, Reiffel said that radiation sharply and suddenly increases as its source is approached. Earlier radiation detectors had to be switched constantly from one scale to another to continue registering accurately the changes in radiation intensity. Even the best of present instruments often do not give meaningful readings at very high or very low radiation levels.

With this new wide-range detector, sudden changes in radiation intensity will be indicated instantly on the instrument's single scale. The result will be that scientists utilizing such devices will be warned quickly of dangerous sources of radioactivity.

The instrument — no larger than the average table model home radio — is comparatively simple to operate, and its small size makes it readily adaptable to portable use in planes, automotive vehicles, and ships.

## HIGH PRESSURE BOILER INSTALLED AT WEIRTON

▲ A new high pressure boiler will be installed at Weirton, W. Va., for Weirton Steel Co., according to the engineer-constructor, Rust Engineering Co.

Designed for a steam capacity of 350,000 lb per hr at a normal rating of 850 psi the new unit will be equipped to burn blast furnace gas primarily with provisions for firing with pulverized fuel and coke oven gas as well.

In addition to the boiler, Rust has already begun work on a blower house and auxiliary equipment for a turboblower which will serve the new No. 4 blast furnace at Weirton.

## LACLEDE REBUILDING PLANT DESTROYED BY FIRE

▲ Construction will start immediately on rebuilding the Canon City, Colo., plant of the Laclede-Christy Co., to replace an installation destroyed by fire last September. Since the fire, an extensive prospecting and evaluation program has been underway in the Canon City area to determine the amount and quality of clays available and to study the economic factors involved. Plans to rebuild the plant were postponed pending completion of research. Research and prospecting results were highly favorable. Deposits of clay which will last 25 years or more were discovered and the clay located is of excellent quality.

The new Canon City plant will be built at an estimated cost of $100,000 and will employ 55 men, the approximate number on the payroll before the fire last fall. The new plant will be devoted to production of clay refractories only. In the past, the Colorado plant also turned out silica bricks.

Construction work will start immediately and is scheduled to be completed within 60 days. It was reported that Laclede-Christy had reached a settlement with the underwriters of the plant for approximately 75 per cent of the cost of the new factory.

## POST ELECTRIC MERGES WITH ELECTRIC SUPPLY

▲ Post Electric Co., of Chicago, Ill., and Gary, Ind., has merged its apparatus distribution facilities with the newly created power apparatus division of the Electric Supply Corp., Chicago, Ill., and Hammond, Ind. Don L. Orton, owner and operator of Post Electric and formerly vice president of sales, Clark Controller Co., will become manager of the new division of Electric Supply Corp. His headquarters will be at the company's branch at Hammond, Ind.

## YALE & TOWNE STARTS RESEARCH DIVISION

▲ In a move to extend its international leadership in both the materials handling equipment and hardware fields, Yale & Towne Manufacturing Co. has established a Research and Development Division.

The newly created research and development division will coordinate and supplement the research and product development activities now being conducted at Yale & Towne's eight manufacturing divisions.

## ILLINOIS GEAR BUYS ADJACENT PROPERTY

▲ Illinois Gear & Machine Co., 2108 North Natchez Avenue, Chicago, Ill., has purchased approximately 200,000 sq ft of additional land, adjacent to their main office and works. The land is situated on the main line of the C. M. & St. P. Railroad, and is served by two sidings. An existing building on the property will be occupied by a pattern shop and pattern storage. The balance of the land will be improved to expand the company's machine shops, heat treating and parking facilities.

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## Pay off under pressure!

### Help maintain record-breaking tonnages by holding downtime to a minimum . . .

Tough? You bet. That's why Ampco screw-down nuts stand up under the tremendous impact and loads developed in blooming-mill operations. They pay off under pressure — keep production up, costs down.

Ampco screw-down nuts are usually centrifugally cast for the sound structure so necessary to provide the tough wear resistance you want. And you can get them in sizes up to 6000 lbs.

Ampco Metal pays off in other critical production jobs as well — providing extra toughness for wearplates, slippers, flash welder dies — and cost-saving corrosion-resistance for pickling equipment and similar applications.

Consult your nearby Ampco field engineer for complete details—he will be glad to recommend Ampco economies.

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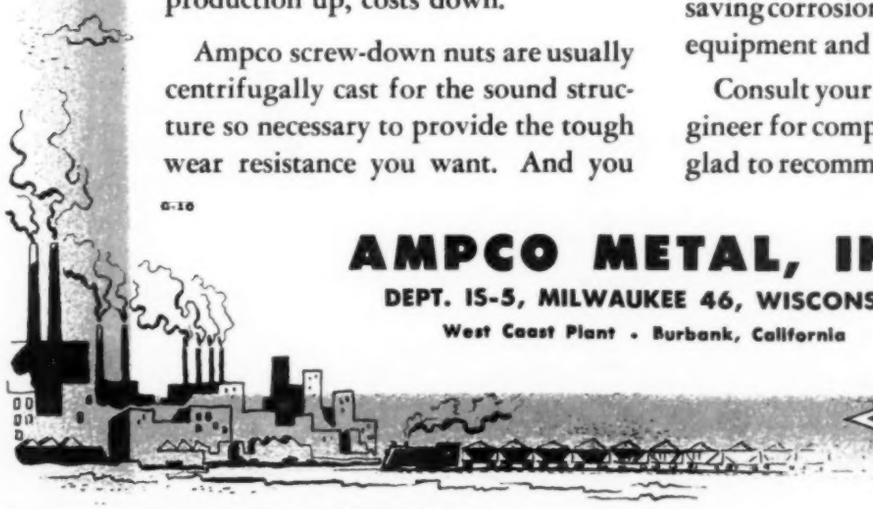
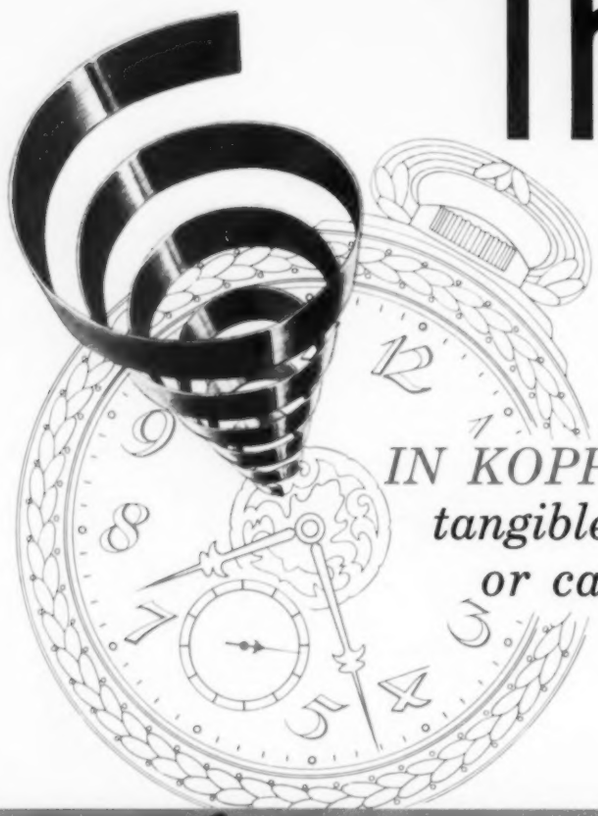


AMPCO®

# The part you c

## *is the thing t*



*IN KOPPERS ENGINEERING . . . the intangible element, the thing you can't see or can't measure, is one of the most important. We call it sureness.*

**These 65 new Koppers-Becker Coke Ovens carbonize approximately 1,400 net tons of coal per day at a coking rate of 1.08 inches per hour.**

# cannot see...

## *that makes it tick!*

SURENESS that guarantees a thorough, dependable job.

SURENESS that provides the most practical solution to the problem.

SURENESS that reduces cost, saves time.

SURENESS that comes *only* with experience.

And look at Koppers experience:

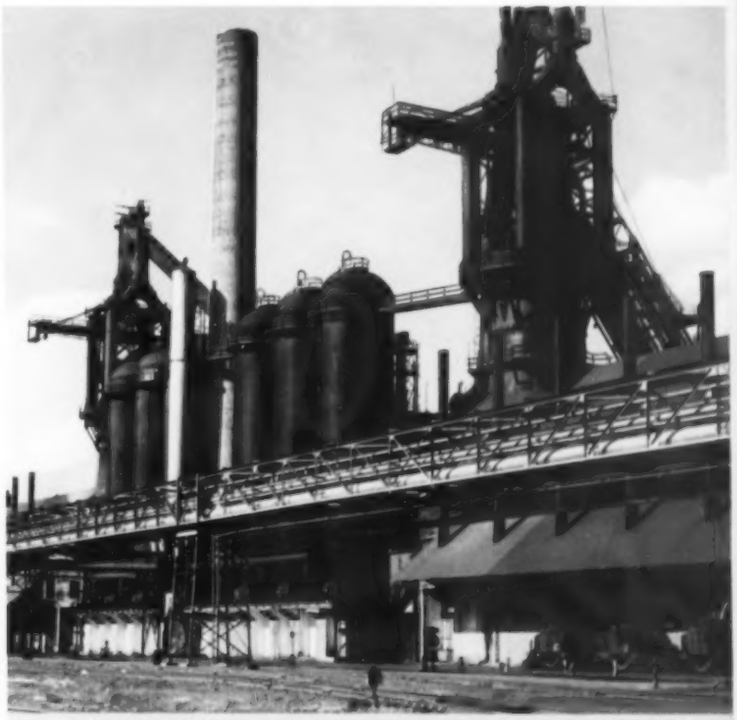
**Coke Ovens—Coal-Handling Systems—Power Plants—Blast Furnaces and Stoves—Mills—Open-Hearth Furnaces—Coal Chemicals Plants.**

In the construction of such facilities all over the world, Koppers talented engineers developed many modern techniques and new answers to old problems that are now accepted as standards throughout the iron and steel industry.

This pioneering has given industry such equipment and techniques as the famous Koppers-Becker underjet oven, Freyn-designed blast furnace, open-hearth and sintering-plant equipment. And it has given Koppers engineers a SURENESS in their approach to engineering and construction problems that counts in final results.

**For any kind of metallurgical construction**
**YOU CAN COUNT ON KOPPERS**

KOPPERS *Engineering and Construction Division*



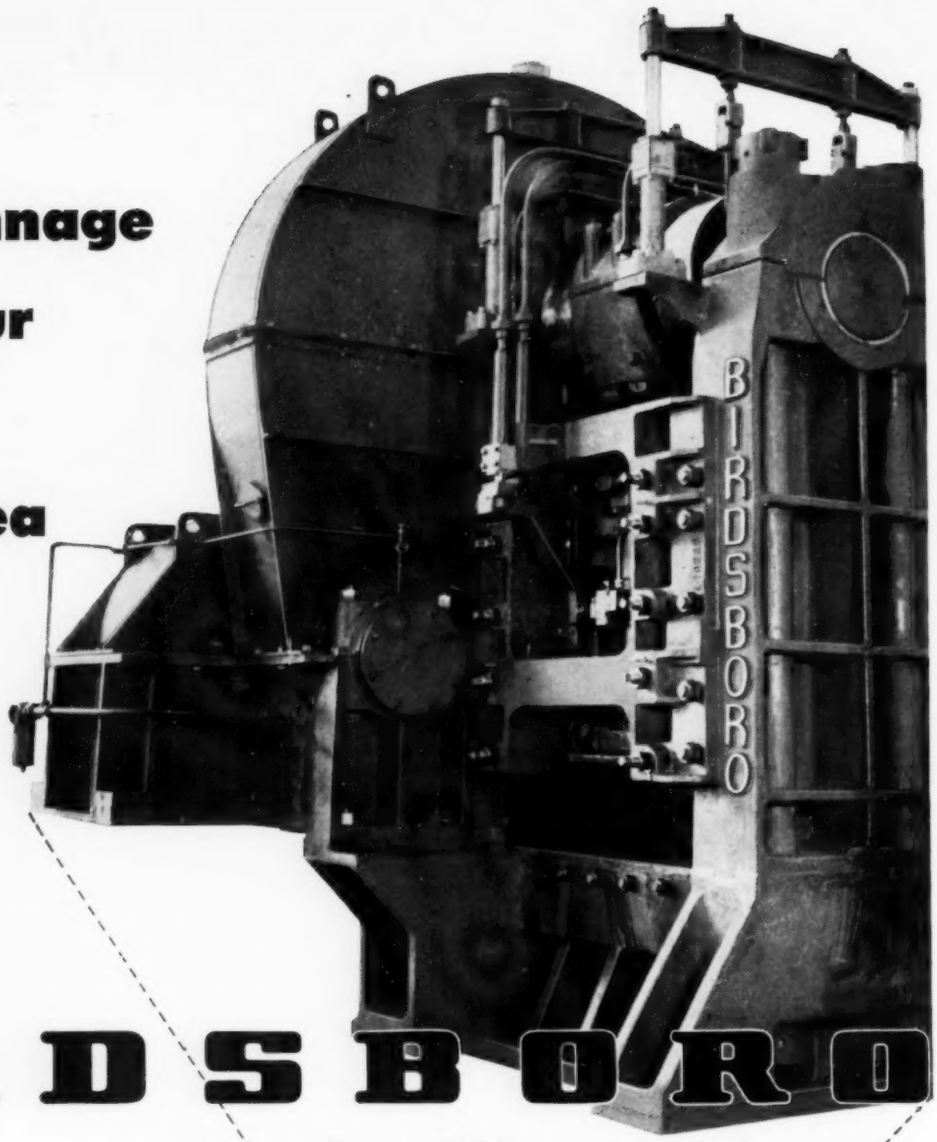
▲ Typical Freyn-designed and constructed blast furnaces and stoves.

▼ Open-hearth furnaces designed and constructed by the Freyn Engineering Department.

***PUT YOUR SHOULDER TO THE WHEEL***
*SEND IN SCRAP TO MAKE MORE STEEL!*

**KOPPERS COMPANY, INC., PITTSBURGH 19, PA.**

# For more tonnage from your present work area




This Birdsboro Bloom and Slab Shear has been designed and built to handle the maximum production of a new 32" Blooming Mill installation.

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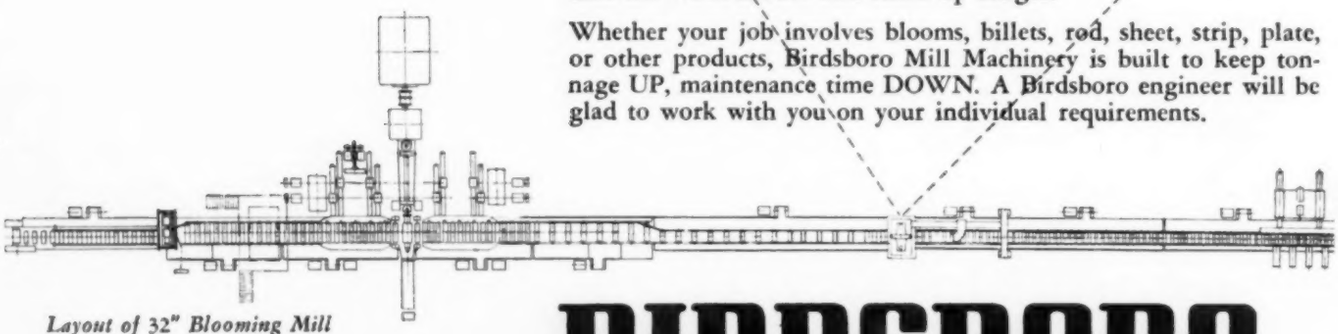
## steel mill machinery

Getting maximum production from every foot of plant space is the demand of the day. And that calls for modern mill machinery that can work harder and stand up longer.

Whether your job involves blooms, billets, rod, sheet, strip, plate, or other products, Birdsboro Mill Machinery is built to keep tonnage UP, maintenance time DOWN. A Birdsboro engineer will be glad to work with you on your individual requirements.



*Layout of 32" Blooming Mill*

# BIRDSBORO

## STEEL FOUNDRY & MACHINE CO.

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*Offices in:*
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*and*
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**1952 IRON and STEEL EXPOSITION**

**CLEVELAND**
***Public Auditorium***

**Sept. 30, Oct. 1, 2 and 3**

# PROGRESS REPORTS FAVOR EXTENDED USE OF NATIONAL CARBON IN BLAST FURNACES

TRADE-MARK

*The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation*

**NATIONAL CARBON COMPANY**
**A Division of Union Carbide and Carbon Corporation**
***30 East 42nd Street, New York 17, N. Y.***

*District Sales Offices:* Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

In Canada: National Carbon Limited, Montreal, Toronto, Winnipeg

● The future of "National" carbon as a preferred material for blast furnace linings is definitely assured by the mounting evidence of its extra long life in hearths and, more recently, in side walls all the way up to the mantle.

Already, indications are that, as carbon goes *up* the furnace, operating costs come *down*. Fewer shut-downs, more uniform casts are consistently being obtained in existing installations. And increased capacity can be expected to result from the use of thinner wall sections, made possible by this ideal furnace-lining material.

Furnace operators are urged to keep their eyes on carbon and on the growing body of data covering its use in modern, high-tonnage-life furnaces.

***WHY BUY THIS ITEM?***

It gives you *double the usable light!*
No metal can to *leak or corrode!*
It can't *stick, swell or jam!*
It delivers the *whitest, brightest light!*

It's the "Eveready" No. 1050 flashlight battery, made with the zinc electrode inside a carbon jacket – just the reverse of every other battery on the market.

Test it and . . . you always buy it!

***OTHER NATIONAL CARBON PRODUCTS***

**BLAST FURNACE LININGS • BRICK • CINDER NOTCH LINERS • CINDER NOTCH PLUGS • SKIMMER BLOCKS • SPLASH PLATES • RUNOUT TROUGH LINERS • MOLD PLUGS • TANK HEATERS**

# Personnel News...

**Irving S. Olds,** having reached the corporation's retirement age, has retired as chairman of the board of directors of United States Steel Corp. and was succeeded as chairman by **Benjamin F. Fairless.** Mr. Fairless, who was named the chief executive officer of the corporation, will continue to serve as president of the corporation, a position he has occupied since January 1, 1938. Mr. Fairless will also continue as president of United States Steel Co., the steel operating subsidiary whose main office is in Pittsburgh, Pa. **Roger M. Blough,** executive vice president-law and secretary, United States Steel Co., was appointed to the post of vice chairman of the board of directors.

**Stephen Vajda,** formerly combustion engineer at Pittsburgh, Pa., works of Jones & Laughlin Steel Corp., has been appointed staff engineer-steelmaking, in the office of the chief engineer.

**O. S. Carliss** was named director of engineering and **George F. Quayle** has been appointed assistant director of engineering of the Philadelphia, Pa., division of Yale & Towne Manufacturing Co. Mr. Carliss succeeds **Charles S. Schroeder** and Mr. Quayle replaces **Frank A. Vossenberg,** who were appointed on April 9 to become respectively director and assistant director of the newly created company-wide research and development division.

**William E. Miller** was appointed manager of the steel mill section of General Electric Co.'s industrial engineering department at Schenectady, N. Y. Mr. Miller succeeds **Hal W. Poole** who has been named manager of engineering for the company's newly-created industry control department.

**John R. Millikin** was named office manager of the Pittsburgh, Pa., branch of Crucible Steel Co. of America. Mr. Millikin joined Crucible in 1948. For the past four years he has worked in the New York and Syracuse tool steel sales divisions of the company.

**Fred Osborne** was elected president of Sloss-Sheffield Steel & Iron Co., Birmingham, Ala. Mr. Osborne had been general superintendent in charge of manufacturing. **Eugene Cosmer,** formerly general superintendent, mining, was appointed vice president, mining.

**Frank M. Fitzgerald** has been appointed manager of the production planning department of U. S. Steel's National Tube division, Pittsburgh, Pa. Mr. Fitzgerald, who succeeds **James E. Smith,** who has retired after 46 years of service with National Tube, had been serving as assistant manager of production planning in the company's general offices.

**Ward A.Wickwire, Jr.,** has been elected president of Salem-Brosius, Inc., Pittsburgh, Pa. Mr. Wickwire, who has held the positions of executive vice-president of the company since 1951 and vice-president since 1947, succeeds **W. A. Wickwire, Sr.,** as president, recently deceased.

**Perry G. Snyder** has joined Youngstown Sheet and Tube Co. as district engineer for the Youngstown district. He succeeds **Ray Fenton** who died January 19. Mr. Snyder who had previously been with Youngstown Sheet and Tube Co., has also had experience with Wheeling Steel Corp. and Koppers Co. In 1925 he rejoined Youngstown Sheet and Tube Co. as a squad leader, became division engineer at the company's Brier Hill plant at Youngstown in 1943 and three years later left to become chief engineer for Aetna-Standard Engineering Co. He held that position until rejoining Youngstown Sheet and Tube Co. recently.

**John E. Spears,** control manager of the Gas and Coke Division of Koppers Co., Inc., since August 1949, has been named assistant general manager of that division at Pittsburgh, Pa.

**Edwin H. Keiper** has been made chief engineer of the Pennsylvania Crusher Co., Philadelphia, Pa. Mr. Keiper was serving as chief service engineer.

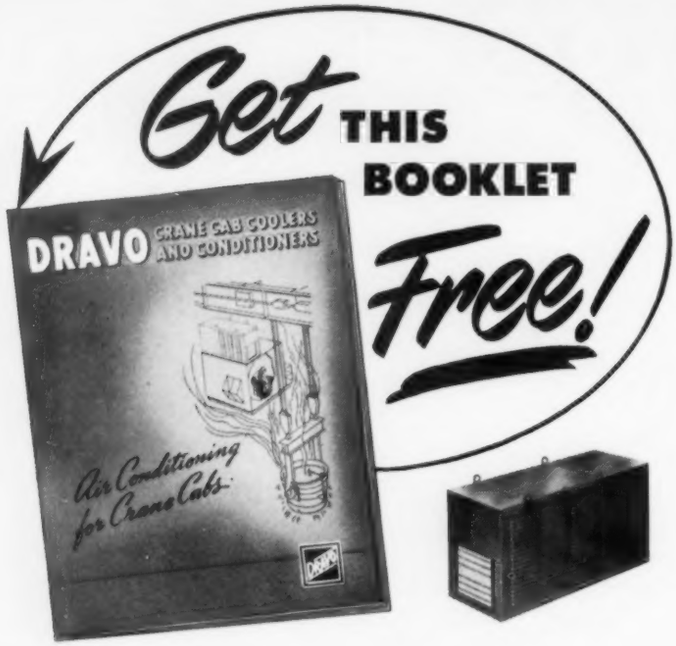
**Arnold E. Blitz** has been appointed Pennsylvania Salt Manufacturing Co.'s sales supervisor in the ordnance field. Mr. Blitz joined Pennsalt as sales-service representative last year when the company began marketing phosphate coatings and lubricants for application to steel prior to cold working.

B. F. FAIRLESS

O. S. CARLISS

GEORGE F. QUAYLE

WILLIAM E. MILLER

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. . . This new 24-page, illustrated booklet will show you how easily this can be corrected with Dravo Crane Cab Coolers and Conditioners. Booklet contents include:

- **Recommended cooling or conditioning equipment for any situation.**
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- **Complete catalog of models and supplementary equipment.**

Dravo Crane Cab Coolers and Conditioners protect your crane cab operator, safeguard his health, increase his efficiency and alertness, and improve safety and production records in your operation. And ONLY DRAVO has a complete line of crane cab coolers and conditioners.

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**MAIL THIS COUPON FOR YOUR FREE BOOKLET**

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Please send me a free copy of "Dravo Crane Cab Coolers and Conditioners."

Name_____

Company_____

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City_____ Zone____ State_____


**George T. Collins** has been elected assistant to the president of the Pennsylvania Salt Manufacturing Co., Philadelphia, Pa. Mr. Collins had been serving as manager of market research and recently has been engaged on special assignments having to do with long-range company planning for the president's office.

**Morse G. Dial** has been elected president of Union Carbide and Carbon Corp., New York, N. Y. Mr. Dial as president, succeeds **Fred H. Haggerson,** who continues as chairman of the board.

**O. B. Wilson** has been made field sales manager for the Industrial Division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa. Mr. Wilson succeeds **William H. Steinkamp** who was recently made general sales manager of the division. Mr. Wilson will supervise all industrial field sales and service personnel for all Industrial Division products.

**John H. Crankshaw** has become associated with J. A. Zurn Mfg. Co. and American Flexible Coupling

JOHN H. CRANKSHAW

Co., Erie, Pa. as executive engineer. He will operate in the field of product design and development in conjunction with the engineering staffs of the companies, both in Erie and other localities. Mr. Crankshaw has been associated with the General Electric Co., Erie Works, Locomotive Division, for a number of years prior to which he was with General Electric in other capacities.

**Walter E. Remmers** was elected vice president — alloys division, Union Carbide and Carbon Corp., New York, N. Y. Mr. Remmers joined Union Carbide in 1936. He has been president of Electro Metallurgical Co. since 1948, and president of United States Vanadium Co. since 1950. Both companies are divisions of Union Carbide and Carbon Corp.

**Gordon W. Cameron,** treasurer of Aluminum Co. of America since 1943, was made vice president and treasurer; **Arthur P. Hall,** director of public relations and advertising, becomes vice president in charge of those fields; and **C. F. Nagel, Jr.,** chief metallurgist, assumes the third new vice presidential post.

**E. D. Youmans,** vice president in charge of manufacturing and research, was elected to the board of directors of Okonite Co., Passaic, N. J.

# IN ALL INDUSTRIES

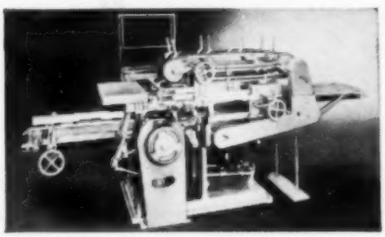
# LUBRIPLATE LUBRICANTS

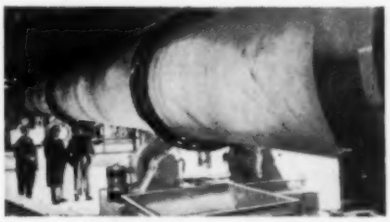
## EXCEL IN REDUCING FRICTION, WEAR, UPKEEP-COSTS AND POWER-CONSUMPTION...WITH BETTER MACHINE PERFORMANCE

**PACKAGE MACHINERY COMPANY of Springfield, Mass., says:**

### "WE RECOMMEND THIS LUBRICANT TO OUR CUSTOMERS"

"We have found LUBRIPLATE Lubricants to be very effective and use them extensively in our machines. To assure the proper use of LUBRIPLATE Lubricants for re-lubrication, we place tags on our machines before shipment. Thus the purchasers of those machines know the LUBRIPLATE Product we recommend for each application and where to obtain it."





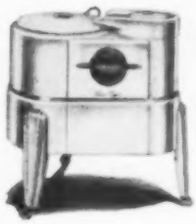
**The BROWN COMPANY, Quality Paper Makers of Berlin, New Hampshire, says:**

### "THIS LUBRICANT SAVED US $2,098.16 IN SEVEN MONTHS"

"During the seven month period before using LUBRIPLATE No. 130AA in the bearings of our Kraft Mill Lime Kiln, we used a conventional oil of the density recommended. The cost of the lubricant for the period was $2,134.00. In the seven months that followed, we only used 128 lbs. of LUBRIPLATE No. 130AA for initial filling and replacement at a cost of $35.84. LUBRIPLATE No. 130AA only requires weekly application whereas the former lubricant required daily application."

### "THIS LUBRICANT SAVES GEARS AND TRANSMISSIONS"

**-says AUTOMATIC WASHER COMPANY, Newton, Iowa**



"We have used LUBRIPLATE in our washing machine transmissions since 1933. Our laboratory tests as well as field experience indicate that through the use of LUBRIPLATE, we reduced the wear on the gears and prolonged the life of the transmission. The transmission is the heart of any washing machine and the long life and trouble-free performance obtained by the use of LUBRIPLATE in the Automatic Washer transmission has been an important factor in the success of our product."

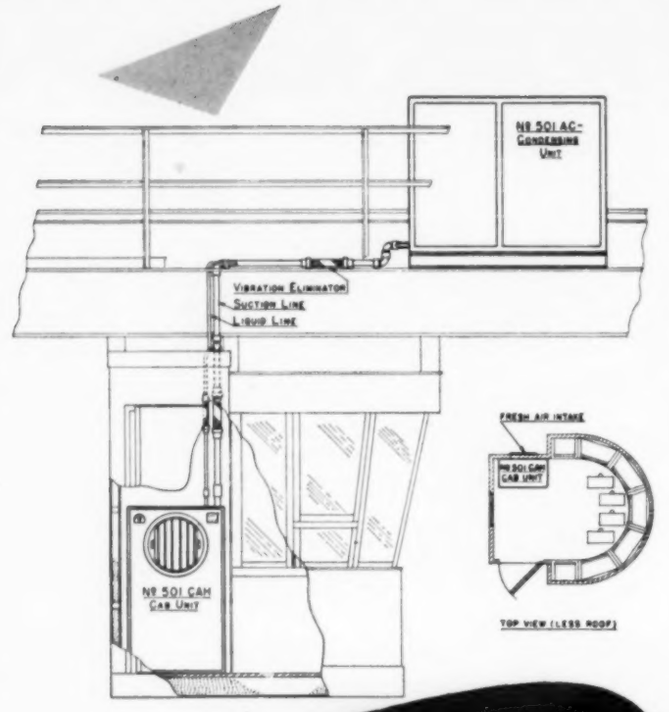
*F. Breckenridge*
Executive Vice-President

**REGARDLESS OF TYPE AND SIZE OF YOUR MACHINERY LUBRIPLATE LUBRICANTS IMPROVE OPERATION AND GREATLY REDUCE MAINTENANCE COSTS.**

*Write today for LUBRIPLATE Data Book No. 1-52*

**LUBRIPLATE DIVISION**
**Fiske Brothers Refining Co.**
Newark 5, N. J. Toledo 5, Ohio

DEALERS FROM COAST TO COAST—SEE YOUR CLASSIFIED TELEPHONE BOOK




## How to Save 2/3 on Your Crane Cab Air Conditioning

By arranging for air conditioning with the Lintern Aire-Rectifier *when buying the crane*, the cost is only about one-third that of installing air conditioning later.

A majority of the steel companies, in their expansion programs, have included air conditioned crane cabs.

Aire-Rectifiers hold cabs at a cool 85° F and relative humidity of 30% to 50% at ambient temperatures of 170° without excessive head pressures or wear on the machine.

In the split system (shown above) the condenser is located at any convenient place on crane, and evaporator (cooling coil) is placed in cab. The two units are connected with refrigerant lines properly secured and protected against breakage. Condensers are air-cooled, assuring trouble-free service with but little maintenance.

May we send you complete information on the Lintern Aire-Rectifier (patents pending) and its application to your particular needs?

**THE LINTERN CORPORATION**
**P. O. BOX 428 • PAINESVILLE, OHIO**

**J. F. Farnam** has been appointed deputy chief of the wire mill branch of the copper division of the National Production Authority. Mr. Farnam, who is manager of industrial and contractor sales for General Electric Co.'s wire and cable department, has been granted a temporary leave of absence from the company. He is taking over the appointment as deputy chief, succeeding **J. H. Crawford,** former sales consultant for General Electric's construction materials division who died March 6 while serving with the NPA.

**Robert D. Crane** was named as materials control superintendent for Morgan Engineering Co., Alliance, Ohio. Mr. Crane will be in charge of purchasing, receiving, and stores. **Theodore T. Buchanan** who has served for more than fifty years has retired as purchasing agent.

**Kenneth H. Hannan** has been elected treasurer of Union Carbide and Carbon Corp., New York, N. Y. Mr. Hannan had served as secretary and assistant treasurer of the corporation since 1949.

**Gordon J. Berry** was elected president of Electric

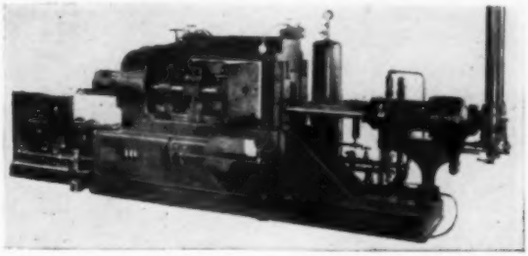
GORDON J. BERRY

Products Co., Cleveland, Ohio. Beginning as a test engineer, Mr. Berry progressed through the service organization, design engineering and sales engineering to his recent position of vice president in charge of sales.

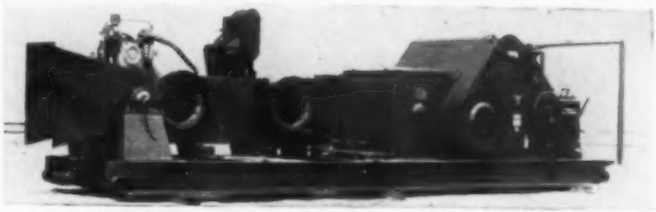
**John A. Robinson** has been named sales manager of the eastern and mid-Atlantic regions for the Industrial Division of Minneapolis-Honeywell Regulator Co. The appointment was also announced of **Joseph J. Matulis** as industrial manager for the midwest region to succeed Mr. Robinson and the promotion of **C. G. Behnke** to industrial manager of the Chicago, Ill., branch office. Mr. Robinson succeeds **O. B. Wilson,** recently named field sales manager.

**Robert M. Whitney** was promoted to the position of sales manager of the Automatic Transportation Co., Chicago, Ill. Mr. Whitney, who joined the industrial truck manufacturing firm in 1936, had been advertising manager since 1948, and was assistant advertising manager for the two previous years. In his new capacity, he will direct sales operations for the company's rider type electric industrial trucks. From 1942 to 1946, he was assistant sales manager in the department he now heads.

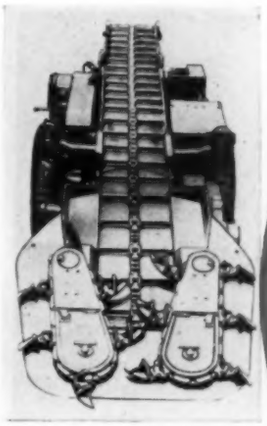
# The Filter that Manufacturers Specify—



DIE CASTING MACHINE. Lester Phoenix, Inc., Cleveland, O.



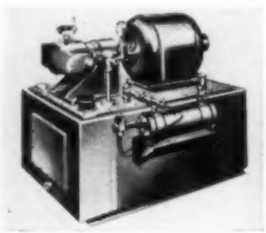
DRILLING RIG. Emsco Derrick & Equipment Co., Los Angeles, California



UNDERGROUND LOANING MACHINE

The Clarkson Mfg. Company
Nashville, Illinois

Hugh B. Williams Mfg. Co.
Dallas, Texas



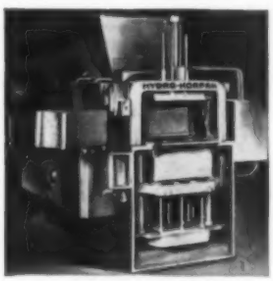
Dennison Equipment Co.
Columbus, Ohio

## O.E.M. Choice of Over 270 Manufacturers

**In 1951 Alone Over 30,000**

## MARVEL SYNCLINAL FILTERS

were specified for O.E.M. or user installation on all types of hydraulic and oil recirculating equipment. Illustrated are machines representative of the many which are protected by Marvel Synclinal Filters. Reasons for this overwhelming preference include: Greater ACTIVE filtering area; Longer operation before cleaning; Simplicity that enables any workman to do the infrequent cleanings quickly and on the spot.



MASONRY BLOCK MAKING MACHINE

W. E. Dunn Mfg., Holland, Mich.

***Write for Data***
***Specify Oil or Water***

***NOW AVAILABLE FOR WATER FILTERING***

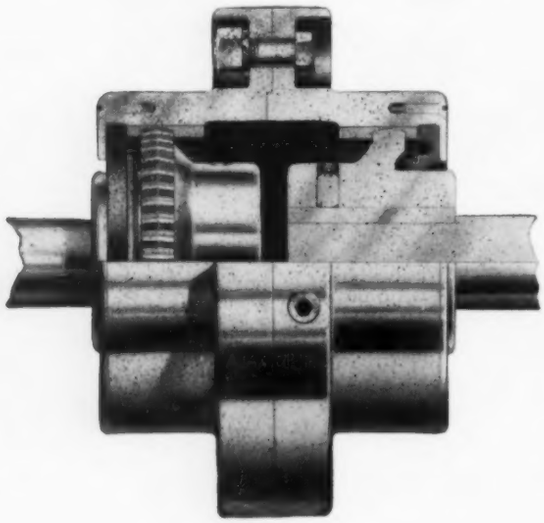
Line types operate in any position and may be serviced without disturbing pipe connections. Both sump and line types available in capacities of 5 to 100 g.p.m. and in mesh sizes from 30 to 200.

**Meets J. I. C. Standards**

**MARVEL ENGINEERING COMPANY**
**625 W. Jackson Blvd. Chicago 6, Ill.**

AJAX DIHEDRAL

**FLEXIBLE COUPLINGS**
***Provide for and Protect Against Excessive***
**MISALIGNMENT**



▶ Mill service breaks the heart of men who use ordinary couplings. Ajax Dihedral Couplings are saving thousands of hours and dollars by eliminating the necessity for precision alignment of motors and other equipment. Change-overs made in minutes instead of hours.

Stock couplings delivered off the shelf to handle misalignment up to 4 degrees. 6, 8, 10 and 12 degree couplings cut to order.

Write for the facts,—experienced coupling specialists in the field give personal service.

**AJAX FLEXIBLE COUPLING CO. INC.**
WESTFIELD, NEW YORK

**M. O. Monsler** has been made manager of Harnischfeger Corp.'s welder and electrode division in Milwaukee, Wisc., after having been sales manager of this division for two years. **W. R. Stephens** is taking over the duties of sales manager of Harnischfeger's welder and electrode division. Before his association with the company in 1947, Mr. Stephens obtained 11 years of experience as a research laboratory metallurgist and electrode sales engineer.

**Stuart H. Smith** has been appointed sales manager of SKF Industries, Inc., Philadelphia, Pa. Mr. Smith, who makes his headquarters at the Philadelphia plant No. 1, of the ball and roller bearing firm, was assistant sales manager prior to his new appointment.

**Everett G. Couch, Jr.,** was recently appointed plant manager of the Taylor, Ky., works of Chas. Taylor Sons Co.

**George V. Slottman** was elected a vice president of Air Reduction Co., Inc., New York, N. Y. Dr. Slottman has been director of research and engineering since February, 1949, and will continue in charge of that activity.

GEORGE V. SLOTTMAN

**E. B. Shaw** has been promoted to supervisor of sales and service, coatings and solvents division of Dacar Chemical Products Co., Pittsburgh, Pa. **E. P. Kramer** has joined the company as district engineer, coatings and solvents division. **D. J. Palmer** has been appointed service engineer in the same department. **H. J. Pollman** has joined the company as district sales supervisor, Michigan district.

**Dr. E. S. Rowland** has been promoted to chief metallurgical engineer of the Timken Roller Bearing Co., Canton, Ohio.

**William C. Schneider** has been appointed sales representative by Selas Corp. of America, Philadelphia, Pa., and his territory will include central and western New York state. Mr. Schneider's headquarters will be in Rochester, N. Y.

**William H. Steinkamp** was named sales manager of the industrial division of Minneapolis-Honeywell Regulator Co. Mr. Steinkamp has been industrial field sales manager since 1943. He succeeds **L. Morton**

"All Motors are NOT Alike"

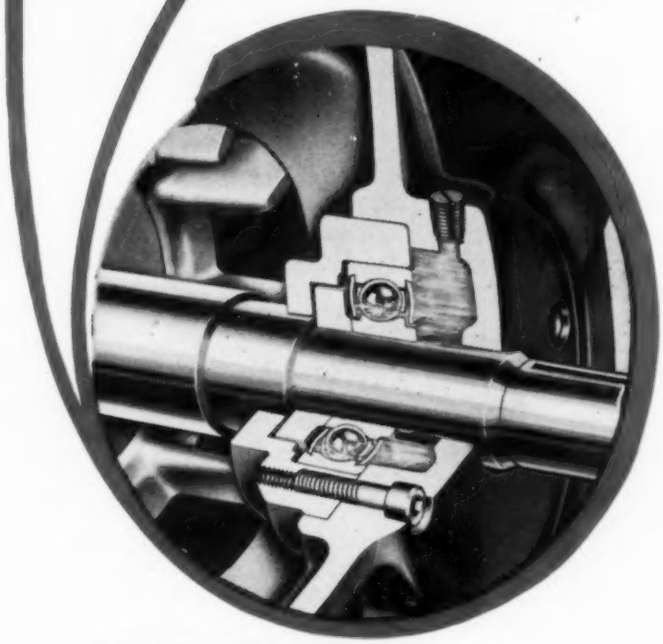
# PRE-LUBRICATED BEARING DESIGN

in

# RELIANCE MOTORS

## provides more operating hours without re-lubrication!

*Reliance PRECISION-BUILT A-c. Motors from 3/4 to 300 hp.*



*Reliance Bearing Design, including extra-large grease reservoir, provides longer bearing life.*

Original, factory lubrication permits more operating hours without re-lubrication than that of any other pre-lubricated bearing. From a larger grease reservoir than provided with any standard bearing, Reliance double-shielded bearings automatically take on new grease as needed. And the Reliance design not only *keeps* bearings lubricated, but makes it *impossible to overgrease* a Reliance Motor. Get the convenient chart on which you can check these and other features which combine to give you 15 important advantages in the Reliance Pre-lubricated Bearing Design . . . write today for Bulletin B-2201.

RELIANCE Precision-Built MOTORS

**RELIANCE ELECTRIC AND ENGINEERING CO.**

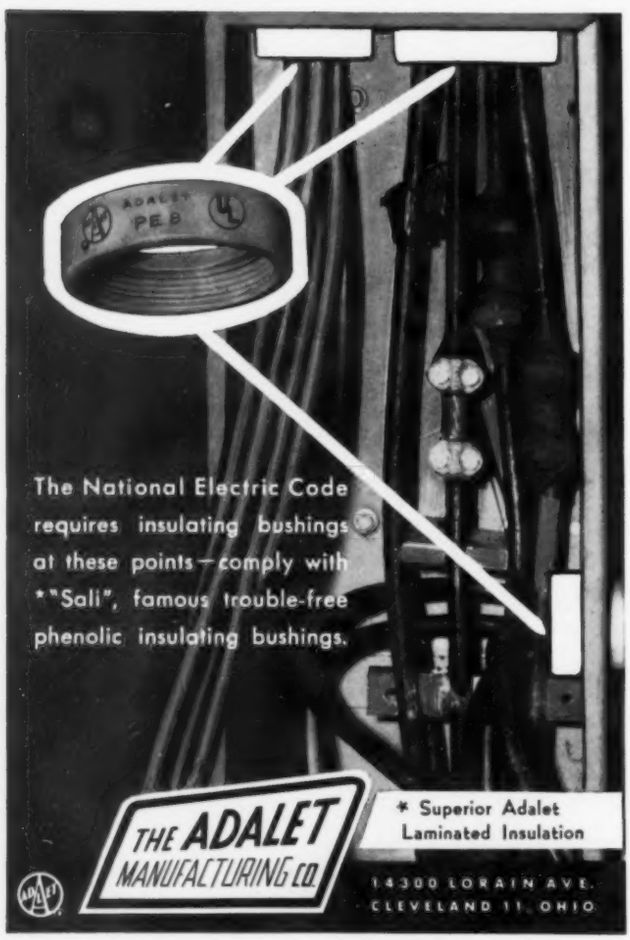
1084 Ivanhoe Road, Cleveland 10, Ohio • Sales Representatives in Principal Cities

Browning Mill Type Cranes are built in accordance with A. I. S. E. specifications. They incorporate the types of motors and controls on which your mill or industry has standardized. This flexibility adapts your VRB crane *perfectly* to your needs. Only the finest materials are employed. Browning heavy duty cranes meet the most rigid demands and satisfy the most critical users. Our design, placing plenty of strength wherever needed, is the outgrowth of 48 years' experience in the crane industry.

*Write for our Bulletin "E".*

"Built as you yourself would build them"

VICTOR R. BROWNING & COMPANY, Inc.
BOX 309, WILLOUGHBY (CLEVELAND), OHIO
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes


The National Electric Code requires insulating bushings at these points—comply with *"Sali", famous trouble-free phenolic insulating bushings.
* Superior Adalet Laminated Insulation
THE ADALET MANUFACTURING CO.
14300 LORAIN AVE.
CLEVELAND 11, OHIO

**Morley,** who continues as vice president of the Brown Instruments division and who will assume greater responsibilities concerning division policies and other company matters arising from the accelerated demand for industrial instrumentation.

**Joseph A. Snook** was appointed vice president in charge of sales of Atlas Mineral Products Co., Mertztown, Pa. Mr. Snook, associated with the company since 1942, served as secretary and purchasing agent prior to this appointment.

**Lee Fraser** has been made production manager of Arma Corp., Brooklyn and Mineola, N. Y., subsidiary of American Bosch Corp.

**Fred W. Schulte** was named sales engineer in the newly opened Dravo Corp. office located at 1110 South Brentwood Boulevard, St. Louis 17, Mo.

**John L. Michaelis,** formerly chief engineer of the New Martinsville plant of the Columbia Southern Chem-

JOHN L. MICHAELIS

ical Corp., has joined Heyl & Patterson, Inc., Pittsburgh, Pa., as contracting engineer. His duties at Heyl & Patterson will be sales and service of the American line of Reineveld centrifuges and separators.

Twenty-six sales engineers have been added to the field sales staff of the Industrial Division of Minneapolis-Honeywell Regulator Co., it was announced recently. The new field salesmen have been assigned to 20 of the company's nearly 100 branch offices in the U. S. The men and cities to which each has been assigned were as follows: **Harry R. Nichols** and **Edward J. Roach** to East Orange, N. J.; **John J. Heavey,** Syracuse, N. Y.; **John M. Caylor,** Harrisburg, Pa.; **Jack M. Fettig, Donald C. Roberge** and **John C. Sharp,** Detroit, Mich.; **Vendel W. Immel,** Saginaw, Mich.; **Alexander W. Spears,** Pittsburgh, Pa.; **Axel H. Magnuson, D. J. McDowell,** and **Harry W. Spongberg,** Chicago, Ill., and **Wilbur J. Smith,** Milwaukee, Wisc. **Robert D. Werckle,** Peoria, Ill.; **Leland K. Smith,** Davenport, Iowa; **John S. Hafling,** Louisville, Ky.; **Glenn Cullen,** Billings, Mont.; **Richard W. Polgreen,** St. Paul and Minneapolis, Minn.; **John H. Tenison,** Houston, Tex.; **Calvin L. Perilloux,** New Orleans, La.; **Robert W. Smith,** Kansas City, Mo.; **Jack T. Teed,** Tulsa, Okla.; **Max R. Curtis,**

# PIPE NORMALIZING—

## Cut From 5 Hours To 3 Minutes With Continuous Heating Line

**SELAS**

**Gradiation**®

### MINIMIZES SCALE...IMPROVES GRAIN STRUCTURE

GRADIATION has set another record in this production war—fast continuous heat treatment of vitally needed pipe.

This new Selas technique of heat treating concentrates and accelerates combustion of fuel in a radiant, flameless heat so that *millions of BTU's* are released with precision control in less time and space than required for the release of *hundreds of thousands of BTU's* in conventional heating equipment.

Continuous pipe normalizing with GRADIATION will produce savings:

TIME . . . 5 hours if done by the batch method; 3 minutes with GRADIATION, plus better results.

STEEL . . . surface oxidation minimized . . . no scale . . . fine grained structure produced with GRADIATION.

LABOR . . . no handling between welding and treatment . . . pipe requires no straightening following treatment.

This new continuous pipe normalizing treatment, with its uniformly fine-grained structure, is just one of the many achievements of GRADIATION in the metal industry. Selas engineers are working constantly with leading manufacturers to design, develop and build new equipment—*heat processing equipment* that will speed the products that are needed—*now.*

**SELAS CORPORATION OF AMERICA**

**PHILADELPHIA 34, PENNSYLVANIA**

***Heat Processing Engineers for Industry — Development • Design • Manufacture***

Salt Lake City, Utah; **Richard E. Roberts** and **Roland T. Williams,** Los Angeles, Calif.; and **Harvey L. Tibbals,** San Francisco, Calif.

**Allen K. Heydrick** has been appointed director of education and training for the Weirton Steel Co., Weirton, W. Va. Mr. Heydrick heads a newly-formed division of education and training which at this time is engaged in an economic education program for supervisory and administrative employees of the company. The new division is a part of the industrial relations department.

**S. Allen Oviatt** was named manager of sales engineering for Kennametal, Inc., Latrobe, Pa.

**Otis R. Carpenter** of the Barberton, Ohio, works of Babcock & Wilcox Co. was appointed an executive assistant of the company. Mr. Carpenter had been serving as director of the works control laboratory.

OTIS R. CARPENTER

**John K. Hodnette,** vice president in charge of industrial products, recently announced the election of three vice presidents to head 12 of the 31 divisions of the Westinghouse Electric Corp. They are:

**W. W. Sproul** has been elected vice president in charge of the Westinghouse Electric Corp.'s general industrial products group of divisions in Pittsburgh, Pa., which comprise the micarta, standard control, small motor, elevator, Sturtevant, welding, and lighting divisions, and Bryant Electric Co. Mr. Sproul, 25 years with Westinghouse, had been sales manager, industrial products. **L. B. McCully** was elected vice president in charge of the East Pittsburgh, Pa., divisions. Mr. McCully had been manager of the same divisions, which are transportation and generator, and switchgear. **H. E. Seim,** was named vice president in charge of the Sturtevant division, with headquarters at Boston, Mass. and also Bryant Electric Co., a wholly-owned subsidiary at Bridgeport, Conn. Mr. Seim had been general manager of both operations.

**John R. Barnes** has been appointed superintendent of blast furnaces, Cleveland, Ohio, district, Republic Steel Corp., succeeding **R. P. Liggett,** who will serve as full-time chairman of the corporation's blast furnace committee. **H. L. Schields** and **W. L. Montgomery** have been named as assistant superintendents.

**L. C. Bridges** has been appointed district industrial engineer, Republic Steel Corp., Gadsden, Ala., succeeding **M. E. Cusick,** who has resigned. Mr. Bridges, who has been assistant district industrial engineer for five years, is succeeded by **R. H. Stange** who has been connected with Republic's industrial engineering department since 1940.

**Lee W. Kehl** has been appointed assistant division accountant for Republic Steel Corp.'s Berger Manufacturing division, Canton, Ohio. Mr. Kehl has been with Republic or predecessor companies since 1925.

## *Obituaries*

**Edward William Tait,** 65, manager of the fabricated products department of Combustion Engineering — Superheater, Inc., died on April 12.

**Irvin S. Reiter,** 54, manufacturing specialist, Bethlehem Steel Co., died April 24. Mr. Reiter, a graduate from Lehigh University, had been with Bethlehem since 1915 and had held a number of positions in the manufacturing division, which includes all forges, foundries, and machine shops.

**E. D. Lyman,** 35, of the Cincinnati, Ohio, office of Crouse-Hinds Co., was killed April 6 in an airplane crash near Morgantown, W. Va. Mr. Lyman was returning from a meeting at the home office at Syracuse, N. Y., in a privately owned plane.

**Eric Plagwit,** 76, recognized throughout the country as the dean of chimney engineers, died suddenly on April 13. Mr. Plagwit had been active in the engineering field for nearly 54 years, and had been head of the chimney division of Rust Engineering Co., Pittsburgh, Pa., since 1924.

**Clarence C. Rausch,** 57, assistant vice president and manager of rust preventive sales, Dearborn Chemical Co., Chicago, Ill., died April 29.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*Mail this coupon to:*
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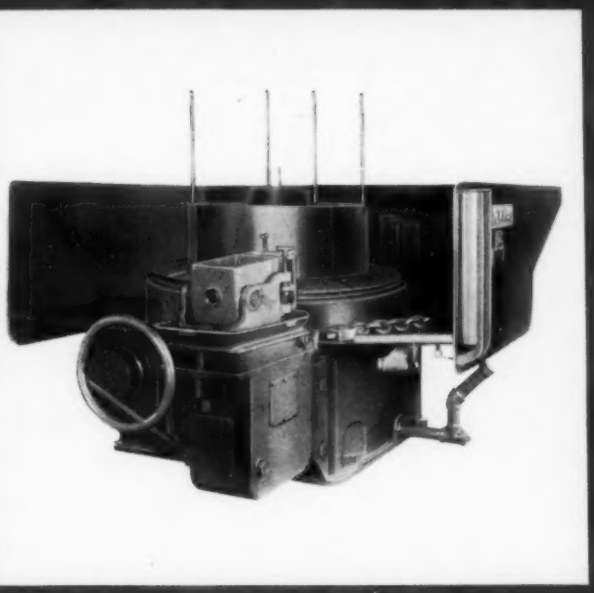
Pittsburgh 22, Penna.



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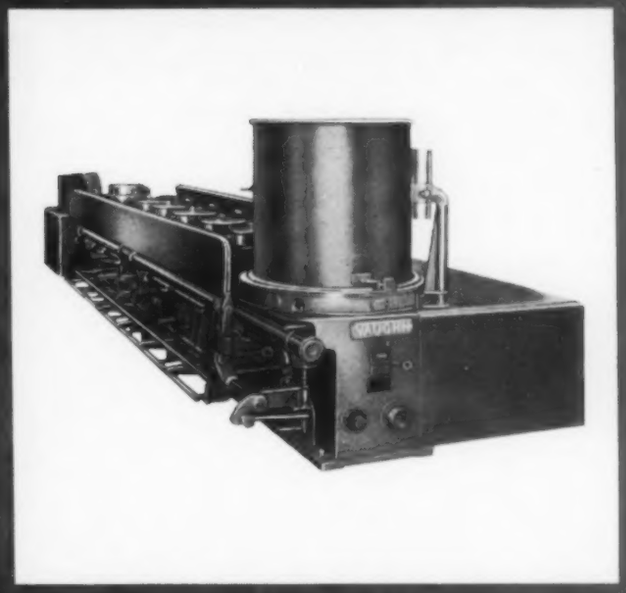

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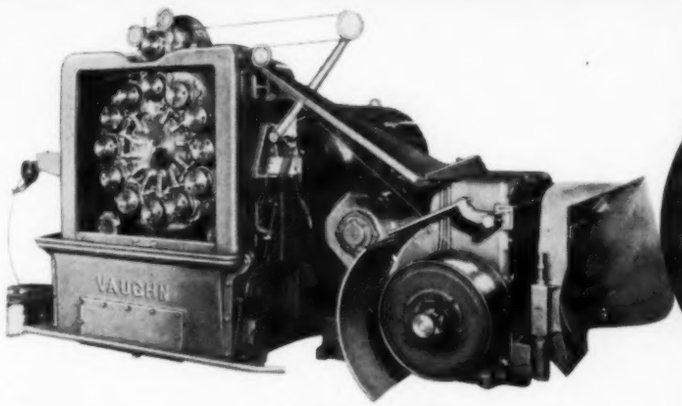
# THE DOMINANT FACTOR

## in greater cold-drawn production



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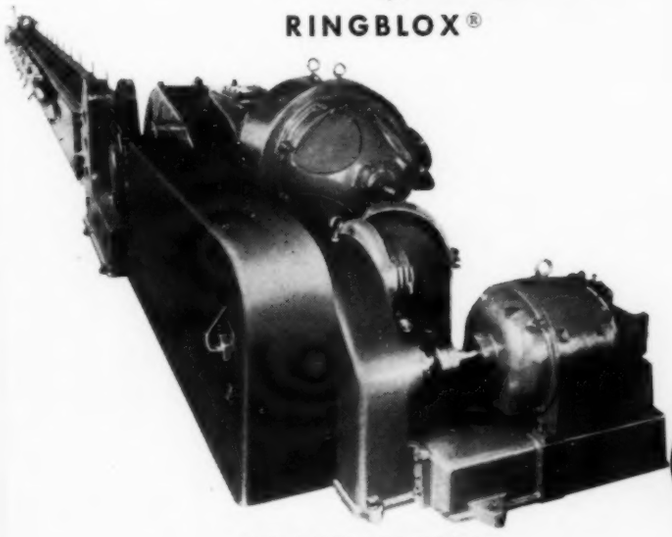

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**Vaughn®**

**cold drawing equipment**

*"Quick on the Draw"*

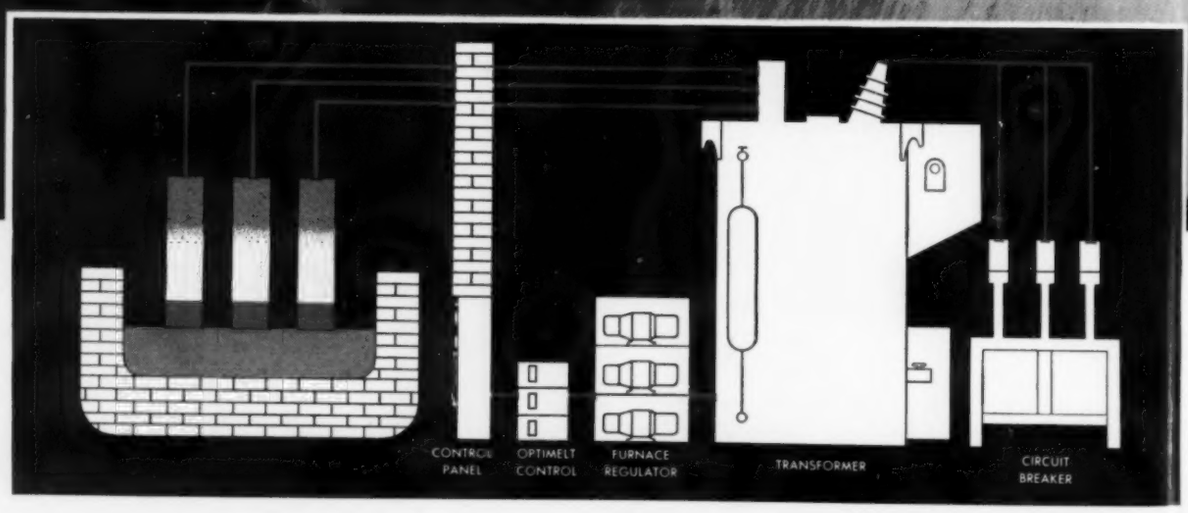
The good name VAUGHN on cold drawing equipment for wire, bars, tubes and shapes means more of everything you want and need—greater productivity, increased versatility, higher stamina and longer life—in sum, more production for your investment dollar. Low operating costs are a VAUGHN factor, too—let us figure them with you!

**THE VAUGHN MACHINERY CO.**

Cuyahoga Falls, Ohio, U.S.A.

COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

***They did what you can do to produce more***



# One of steel's toughest electrical problems is solved this way:

Arc furnaces give electrical apparatus one of its toughest assignments. They slam dead shorts across transformers. They rip open circuit breakers 30 to 100 times a day. And they demand ultra reliability because a power failure can be disastrous.

### *In the midst of violence: precise regulation*

Yet in the midst of this violence they also demand *precise electrical regulation* because power is a major cost item and how it is used vitally affects production rates. For these special requirements, Westinghouse has produced special equipment. Today, more Westinghouse furnace equipment is in use than all other makes combined.

### *Radically designed transformers and breakers*

When the furnace electrode touches the charge, a tremendous power surge tries to rip the transformer apart. So Westinghouse supplies its radical *shell-form* transformer which is far stronger than the conventional construction. Similarly Westinghouse supplies special compressed-air circuit breakers which operate seven times longer between maintenance periods than ordinary breakers.

### *Furnace is regulated by electrical brains*

The real trick in running the furnace is maintaining desired power input. Rototrol® does this by watching furnace conditions and continuously adjusting electrode height. But the ultimate refinement is the Westinghouse Optimelt® control which automatically determines the best kw input (according to furnace conditions) and then directs the Rototrol to hold it there.

### *Call Westinghouse early on EVERY project*

This equipment is a good example of the engineering that Westinghouse applies to steel mill problems. When *your* next project comes up, call Westinghouse early in the planning stage.

### *FREE BOOK ON ARC FURNACES*

This 20-page booklet tells how modern Westinghouse equipment can improve your operations and cut costs. Write for B-4695 "Westinghouse Equipment for Arc Furnaces"—Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa.

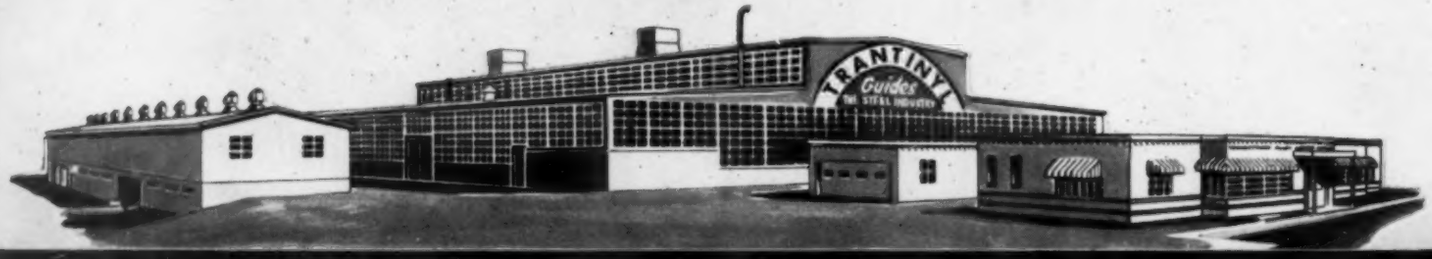
YOU CAN BE SURE...IF IT'S
Westinghouse

EQUIPMENT FOR
STEEL PRODUCTION

J-94939

# TRANTINYL

## guides the steel industry




YOUNGSTOWN ALLOY CASTING CORP., • YOUNGSTOWN, O.

ROLLING MILLS: bar, hoop, strip, shape mill guides, and rollers. SEAMLESS TUBE MILLS: guide shoes, rolling mill plugs and rolls, piercer points, etc.
ELECTRIC WELD TUBE MILL: forming rolls, planishing rolls, tool holders, etc. • STRAIGHTENING MACHINE GUIDES • HEAT RESISTING CASTINGS

→ **for sturdy reliability**

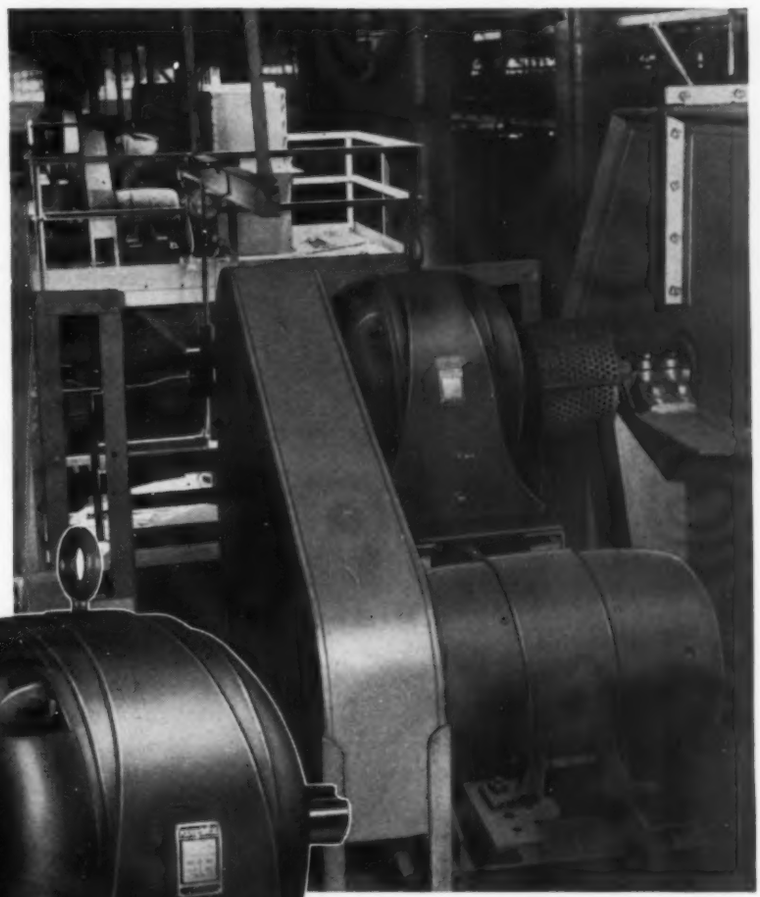
→ **low original cost**

→ **low operating cost**

# LINE-O-POWER DRIVES

Here is one of a number of compact Foote Bros. Line-O-Power Drives installed in the Ford Motor Company Dearborn Specialty Foundry Rouge Plant. These drives are transmitting power to the bucket conveyors that raise sand to the hoppers.

Heavy loads, continuous service, dust conditions, all try the stamina of enclosed gear drives in applications such as this. Line-O-Power Drives have proved their ability to stand up, even under such tough conditions, and to assure long, trouble-free service.

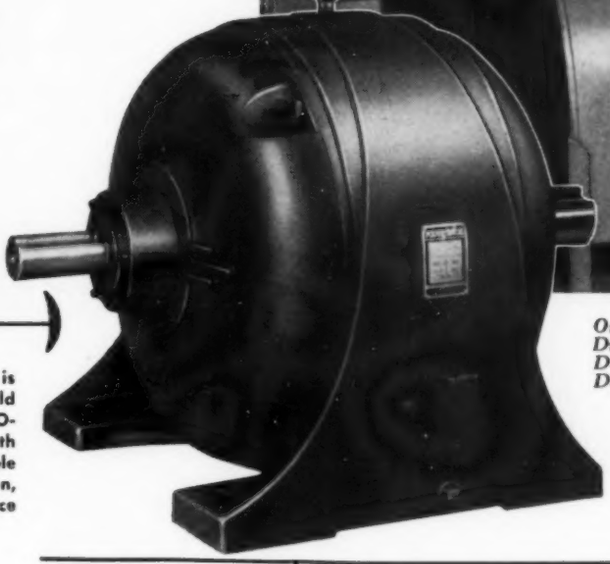


*One of the many Foote Bros. Line-O-Power Drives installed in The Ford Motor Company Dearborn Specialty Foundry Rouge Plant, Detroit.*

## FOOTE BROS. LINE-O-POWER DRIVES OFFER THESE FEATURES

**Duti-Rated, high hardness gearing**
**Rugged cast iron housings**
**Modern streamlined design**
**Simplified construction**
**Direct splash lubrication**
**Efficiencies of 96% or higher**
**Capacities from 1 to 175 h.p.**
**Double or triple reductions**
**Ratios 5 to 1 up to 238 to 1**

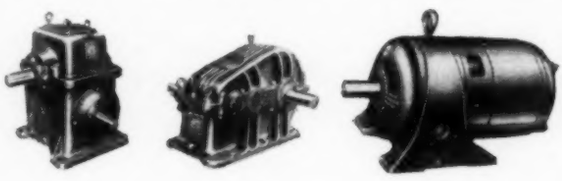
**FOOTE FORMSPRAG BACKSTOP**



**When one direction of rotation is desired and reverse direction would cause damage or danger, Line-O-Power Drives may be equipped with the Foote Formsprag Backstop. Simple in design, rugged in construction, this unit will give years of service with minimum maintenance.**

FOOTE BROS.

*Better Power Transmission Through Better Gears*



Foote Bros. Gear and Machine Corporation
Dept. IAS, 4545 South Western Boulevard
Chicago 9, Illinois

Please send me a copy of Bulletin LPB on Foote Bros. Line-O-Power Drives.

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Company.....

Position.....

Company Address.....

City.....Zone.....State.....

## 26″ STRUCTURAL MILL

BUILT BY MORGAN Engineering

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BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS

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STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES

SPECIAL MACHINERY FOR STEEL MILLS

**THE MORGAN ENGINEERING CO.**

ALLIANCE, OHIO PITTSBURGH—1420 OLIVER BUILDING

Illustrated is a 26″ Three-High Structural Mill, consisting of one 26″ Three-High Pinion Stand connected to two Three-High Roll Stands and one Two-High Pinion Stand connected to one Two-High Finishing Stand.

For serving this mill, there was furnished four Traveling and Tilting Tables and four Traveling Trailing Tables.

*Your inquiries for mill equipment will be appreciated.*

# Equipment News...

## STEEL HARDENABILITY

▲ A tool to help improve defense production has been made available, free of cost, to all American manufacturers of steel, United States Steel has announced.

Research officials explained that the "tool" is not a "gadget," but a patented method for predicting in advance the hardening characteristics of steel compositions. As varying degrees of "hardenability" are indexes to the usefulness of steel for specific tasks, this knowledge will enable operating men to produce the types of steel that will exactly suit such diverse assignments as tough tank armor, strong struts for aircraft, brittle fragmentation bombs, or easily formable cases for shells.

Conversely, the patented method makes possible the design of steels of required hardening characteristics from the available supply of steelmaking materials. Since many alloying elements normally used for special steels are now in short supply and others would be short if war blocked world sea lanes, the new method will be of great assistance in making maximum use of existing supplies of traditional elements or of other elements that may be substituted to give approximately the same service.

Patent was issued July 3, 1951, in the name of Marcus A. Grossmann, and assigned to United States Steel Co., where Dr. Grossmann is adviser in research planning. The patent was recently dedicated to the public by U. S. Steel. This action makes it available to all interested parties.

The "hardenability" of a steel, Dr. Grossmann asserted, is measured as the depth from the surface to which a given steel composition hardens when quenched. Steel men have known for many years that hardenability in general depends on the chemical composition of a steel—the quantities of various ingredients, such as carbon, manganese, molybdenum, chromium, nickel and others, that are added to iron to make different kinds of steel. By careful experiments and tests of his results, Dr. Grossman was able to assign definite hardenability values to these elements. By now great tonnages of steel have proved the validity of his findings.

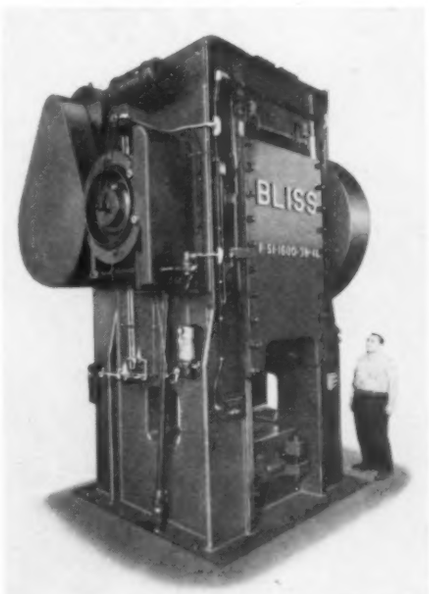
"In the past," Dr. Grossmann said, "we knew roughly which alloying elements improve the hardenability of steels. Now by multiplying the hardening factors, we arrive at a closer approximation. This knowledge helps to rationalize and inject order in our metallurgical planning.

"The most important use of the patent is in conserving our dwindling supplies of certain scarce alloying materials. In one column we can set down the hardenability we need for a given job, as in defense production. In a parallel column we set down the quantities of alloying elements we have to work with. With this information and the new data we can then design steels of required hardenability from our available materials."

## FORGING PRESSES

▲ Development of an improved line of high-speed forging presses is announced by the E. W. Bliss Co. Available in capacities from 300 tons to 4,000 tons, the new line features a heavy duty air friction clutch and an air release spring set brake, both mounted on a full eccentric main shaft. The welded steel frame is designed with the main stress members located immediately adjacent to either side of the die seat and extending from the bottom of the bed to the top of the crown. These members have unusually heavy sections to keep the elongation of frame to a minimum when load is applied to press. A heavy plate, integral with the two front gibs, is bolted securely to the main stress carrying members. This plate, in addition to massive frame tying members in the rear of the press, opposes the inward deflection of frame toward the slide ways. The front of the slide has long and continuous gib ways extending up into the crown to keep the dies in alignment when off center loads are applied.

**These high-speed forging presses are available in capacities from 300 tons to 4000 tons. The new line features a heavy duty air friction clutch and an air release spring set brake, both mounted on a full eccentric main shaft.**




Regular equipment furnished with the press includes a cam knockout in the slide and a cam liftout in the bed. The die seat is a self-contained unit, equipped with an easily operated wedge adjusting mechanism. This mechanism is arranged so that the die seat can be bumped to the correct front-to-back alignment without disturbing the adjusting mechanism. Wedges can be inserted between the die seat and the frame uprights of the press for precision side-to-side alignment of the die seat.

To assist smooth operation at the relatively high speeds at which these presses operate, a "buffer" cylinder is installed in the crown which assists the brake in stopping the heavy slide at top stroke and furnishes additional accelerating force when starting the slide, easing the load on the clutch. A load indicator, which registers the actual load on the press by measuring the elongation of the frame uprights, is furnished as standard equipment.

## MEASURING INSTRUMENT

▲ A new receiver for measurement and control of flow and liquid level has been developed by the industrial division of the Minneapolis-Honeywell Regulator Co.

The new instrument, an "Electro-

niK" inductance bridge receiver, combines in a single instrument a number of functions which formerly required the use of two instruments.

For example, the new instrument makes it possible to indicate, record, integrate and control flow and liquid level. Data can also be retransmitted pneumatically to a second receiver remotely located. An Indexet mechanism is available to reset the control index from a remotely located transmitter.

Incorporation of these functions in one instrument case is an important factor in many applications where conservation of panel space is a vital consideration.

Accurate to within plus or minus ½ of 1 per cent of full scale the instrument combines the time-proven inductance bridge transmission system with the Brown "Continuous Balance System" for power positioning of the pan.

Easily installed in replacement of older inductance bridge receivers, the new instrument does not require any special provisions or extra equipment. The new receivers can be used with any of Brown Instruments' electric flow or motion transmitters.

## HIGH-LIFT TRUCK

▲ A new 4000-lb capacity high-lift platform truck with an extra-large 80 cu ft end-dump hopper is available from Yale & Towne Manufacturing Co., Philadelphia Division. It is designed for handling bulky loads of loose material such as sand, gravel,

aggregate, metal chips, ashes, and scrap.

The hopper can be tilted downward to scoop up loads, or it can be loaded from overhead. The truck is electric high-lift platform truck with a specially shortened platform to accommodate the hopper. The platform elevating mechanism is used to dump the hopper.

## VOLT-AMMETER

▲ The new Columbia Type AC-1 volt-ammeter is a clamp-type, hand-sized measuring instrument that does two separate jobs, measures volts and amperes, instantly and accurately. This new instrument has just been announced by Columbia Electric Mfg. Co. to supplement its long-established line of tong test ammeters.

Readings are made without breaking circuit or insulation. To read amperes the convenient trigger is pressed, opening the pair of insulated jaws so that they can be easily encircled around the power cable or bus bar. The jaws will accommodate cables up to 1½ in. in diameter and bus bars up to 2 in. x ½ in. Four amperage ranges are available: 0-12, 0-60, 0-120, 0-600 a-c amperes.

Voltage leads are quickly and safely plugged into the handle of the instrument. Two voltage ranges are available, 0-150, and 0-600 a-c volts.

Small enough to insert in a pocket, the instrument is easily held and


Make your own tubes & sections

Whatever the shape or length, and in sizes from ½" to 4½" diam. Henderson Machines will make tubes and sections for you in your own factory at speeds ranging up to 130 feet per minute, dead straight, cut off to your exact requirements and cool enough to handle.

Henderson Machines include:

Electric Fusion Tube Mills for steel tubes. Atomic Arc Tube Mills for tubes in stainless steel.

Section Rolling Machines for cold rolled section in Ferrous or any other ductile material.

Air Hydraulic Press (4 ton) for Tube manipulation.

De-Frazing Machine for the inside and outside ends of tubes.

*Please write for full particulars.*

*Illustration shows a Henderson Atomic Arc Tube Mill for producing stainless steel tubes.*

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# How to beat a legal "threat" on WASTE DISPOSAL

WITH STATE AFTER STATE now imposing legal restrictions on industrial waste disposal, you may be faced with this problem quite suddenly. Only by starting to gather complete data *now* can you be prepared for necessary action when that time comes.

A waste disposal survey, which will determine the treatment method that may be required, involves metering the plant effluent and determining its composition. Application Engineering Data Sheet 831-1 gives general information and installation details of float-and-cable metering equipment for this purpose, while Data Sheet 833-2 describes conductivity and pH measuring equipment often used for the measurement of effluent quality.

Write for copies of these publications, as well as for engineering data sheets on instrumentation for various methods of waste treatment. **The Foxboro Company, 585 Neponset Avenue, Foxboro, Mass., U.S.A.**

**TYPICAL FOXBORO INSTRUMENTS THAT LEAD TO BETTER WASTE DISPOSAL**

The Model 40 . . . "The finest modern controller" . . . is the foundation of many outstanding Waste Disposal Systems. It is used for the control of flow, pH, conductivity, temperature and other variables. Thousands are in use daily.

Foxboro Float and Cable Type Instruments are specifically designed for use on weirs and Parshall flumes. They read directly in *flow*.

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AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet
Subject: IMPROVED DRAWING AND COLD FORMING WITH GRANODRAW

## INTRODUCTION:

When steel is phosphate coated with "Granodraw" prior to working it, drawing, extrusion, and other cold forming operations are greatly improved. In fact, the protective phosphate coating makes the cold extrusion of steel possible.

Getting cold steel to flow depends on the unique properties of this coating. Its non-metallic phosphate crystals are physically and chemically adapted to acquire a strongly adsorbed lubricant. The combination of adherent phosphate coating and adsorbed lubricating film possesses a low coefficient of friction while maintaining its integrity under extremely high deforming pressures.

The drawing of wire and many other cold forming operations — including the cold extrusion of steel — are greatly facilitated by the application of a "Granodraw" phosphate coating and a suitable lubricant prior to working.

## "GRANODRAW" DATA

"Granodraw" zinc phosphate coating chemical is applied to pickled surfaces in an immersion or spray process. When used with a suitable lubricant, the coating reduces friction under conditions of low, medium, or high deforming forces encountered in such typical operations as: cold extrusion of steel; cold shaping; deep drawing (tubs, cartridge cases, shells, etc.); stamping; drawing of wire and tubing; ironing; necking; nosing; and upsetting.

## ADVANTAGES OF PHOSPHATE COATING WITH "GRANODRAW" PRIOR TO COLD FORMING STEEL

The following are among the advantages indicated for phosphate coating with "Granodraw" prior to cold forming steel:

*Drawing of wire, bars, tubing, etc.* — Improved lubrication; improved surface; less scratching; reduced pull; greater percent reduction per pass; reduced die wear; longer die life; lower die maintenance and cost; reduction in corrosion.

*Drawing of stampings, shells, shell cases, etc.* — Improved lubrication; reduced breakage; reduction in scrap; deeper draws; less scratching; elimination of some annealing; less wear on dies.

*Cold Extrusion* — Improved lubrication; increased strength of parts; improved surface; reduction in load on press; greater dimensional accuracy; more uniform wall thickness; longer extrusions; elimination of some annealing; less corrosion.

CHEMICALS ACP PROCESSES

WRITE FOR FURTHER INFORMATION ON "GRANODRAW" AND ON YOUR OWN METAL PROTECTION PROBLEMS.

CHEMICALS ACP PROCESSES

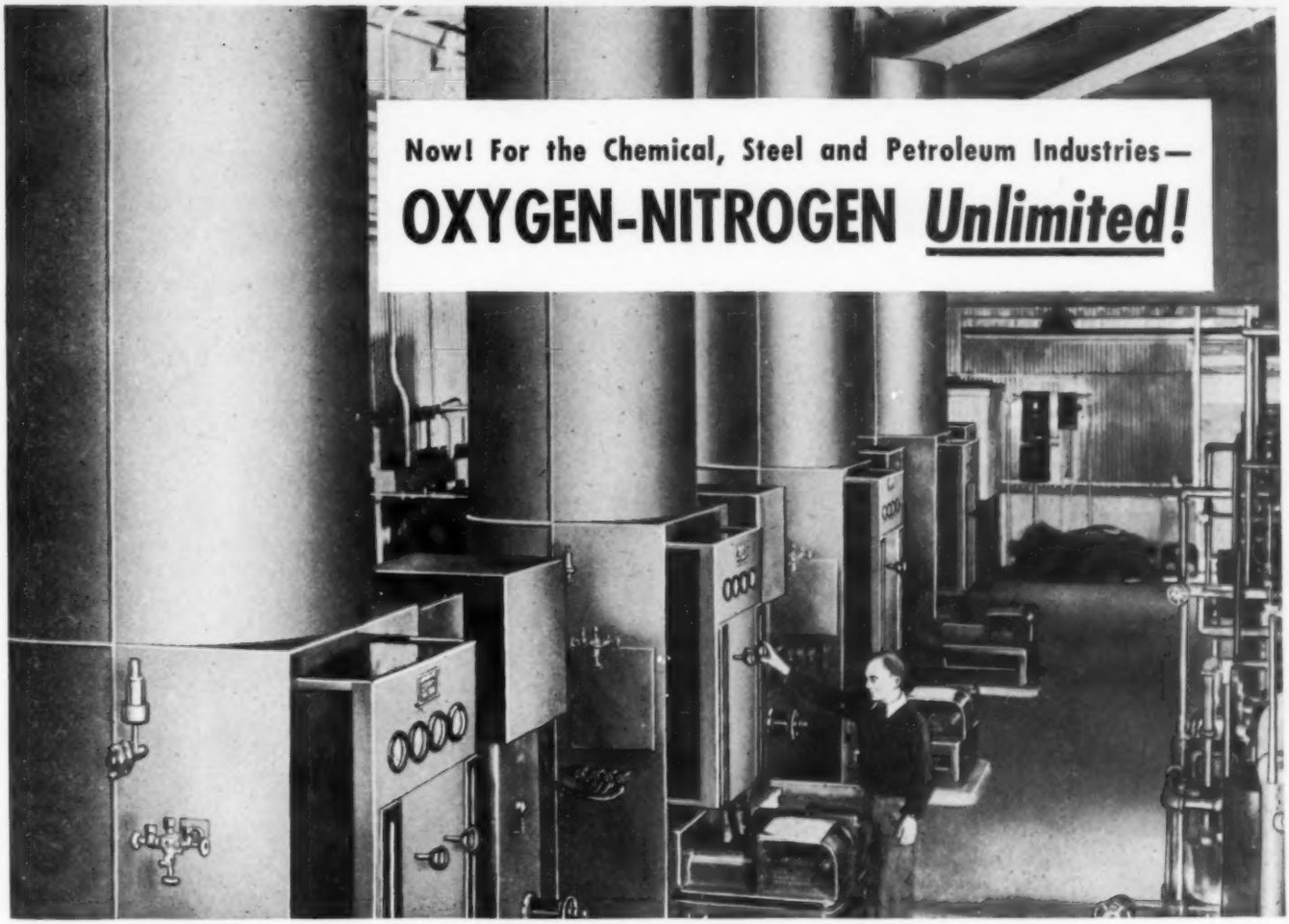
operated with one hand. It weighs less than two pounds. Overall dimensions are 11 in. x 3½ in. x 1⅞ in.

The trigger and housing of the instrument are ruggedly constructed of a durable molded phenolic material. Accuracy is plus or minus 3 per cent of full scale deflection. Complete unit includes voltage leads and carrying case.

## HEAT-RESISTANT ALLOY

▲ Conservation of vitally-needed nickel and chromium in heat resistant castings is the objective of important research just announced by the Alloy Casting Institute of Mineola, N. Y. Conducted at the Battelle Memorial Institute, research has been concentrated on developing a heat resistant material of lower alloy content than the high nickel alloys frequently used in 900-1400 F service. From knowledge of the iron-chromium-nickel alloy system and field experience, casting metallurgists selected an alloy containing 21 per cent chromium and 9 per cent nickel, designated as the HF type, as the material most likely to provide the combination of strength and corrosion resistance required for "intermediate temperature" (900-1400 F) service. Tests to date indicate that this alloy offers a promising solution to the requirements of such service.

Several years ago it was recognized that increased use of industrial processes operating in the 900-1400 F temperature range would create a demand for a somewhat lower alloyed material than the grades normally employed at higher temperatures. A limited alloy development study was authorized by the Alloy Casting Institute as part of the broad high temperature research program sponsored




A typical Air Products high purity Oxygen-Nitrogen Generator installation in one of America's larger steel plants.

## High or low purity—small or large quantities made at your plant from air

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St. Francis Hospital
Libbey-Owens-Ford Glass Co.
National Steel Corp. (Weirton Steel Company)
Pettibone Mulliken Corp.
Pittsburgh Steel Foundry Corp.
Ross-Meehan Foundries
and U. S. Armed Services

**Many of these installations have been operating constantly for years.**

**What are your requirements?** *Pure, dry* oxygen or nitrogen, gas or liquid? *Tonnage* oxygen or nitrogen, gas or liquid? Some *combination* of these?

Whatever your needs, versatile Air Products Generators can fulfill them. Today, many installations are in operation with oxygen capacities from 200 cubic feet to 500,000 cubic feet per hour. Additional tonnage oxygen-nitrogen generators are now under construction. Equipment for virtually *any* capacity, *any* purity, and *any* pressure is available.

**To find out how** you can use the free air to make your own oxygen and nitrogen, talk over your requirements with Air Products Engineers. They have designed, built and put into successful operation *more than 400* oxygen-nitrogen generators. This is your assurance that Air Products equipment will (1) incorporate the most advanced cycles for your particular requirements, and (2) will do the job, and do it dependably.

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PORT HOPE, ONTARIO

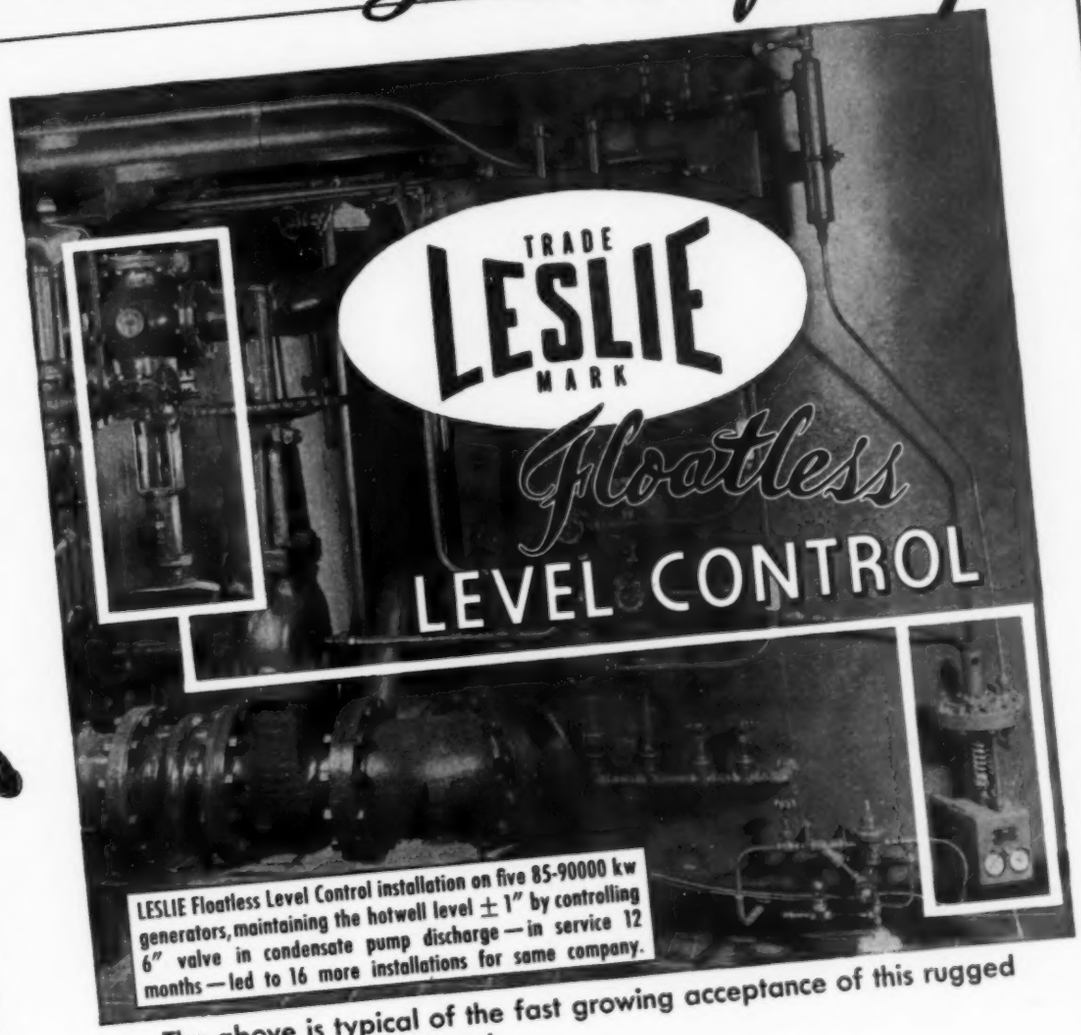

at Battelle for many years by the national organization of high alloy foundries. But when the post-Korean rearmament program rapidly brought about a shortage in the nickel supply, this added incentive caused the project to be given prime consideration, and intensive work was started in October 1950.

By June 1951 the nickel shortage became so acute that the National Production Authority started a program of "downgrading" alloys. This was formalized for heat resistant materials by order M-80, Schedule C, issued last December. The order places maximum limits on the nickel and nickel-chromium contents permitted for various temperature zones. For certain furnace parts and for oil refinery, synthetic rubber processing, cement mill and power boiler equipment in the intermediate temperature zone, the order limits maximum nickel content to 11 per cent. Thus, alloys of the HF composition are the maximum permitted by the order for such uses.

The Battelle research team, under the supervision of J. H. Jackson, is now investigating a series of 14 compositions within the HF alloy specification range, to determine which compositions will offer optimum mechanical properties at elevated temperatures. If the present research on HF alloy continues favorable, then users should be able to substitute this grade in many intermediate temperature applications for materials containing from 30 to 100 per cent more nickel, thereby freeing supplies of this vital element for higher temperature applications, where its use is indispensable.

The HF grade probably would have been investigated for this use a long time ago, except for the mistaken assumption that its properties in the 900-1400 F range are markedly inferior to the higher alloy materials now used. This incorrect idea doubtless arose from the fact that the wrought stainless steels containing about 18 per cent chromium and 8 per cent nickel, have considerably less high temperature strength than the cast alloys of the 25 per cent chromium-12 per cent nickel and the 35 per cent nickel-15 per cent chromium types. However, this is not true in cast alloys, since the latitude of compositions possible in cast alloys allows use of chemical ranges unsuited to wrought alloy production. Tests

# An Outstanding Record of Acceptance!




LESLIE Floatless Level Control installation on five 85-90000 kw generators, maintaining the hotwell level ± 1" by controlling 6" valve in condensate pump discharge — in service 12 months — led to 16 more installations for same company.

The above is typical of the fast growing acceptance of this rugged and accurate level control.

**ADVANTAGES**

- EASY TO INSTALL
- ACCURATE REGULATION (± 1" Water Column)
- NO FLOATS, STUFFING BOXES, ETC.
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- DIAPHRAGM PRESSURE ELEMENT
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**Applications:** On open and pressurized vessels, including boilers, tanks, evaporators, heaters, standpipes, etc.

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PUMP GOVERNORS • TEMPERATURE REGULATORS
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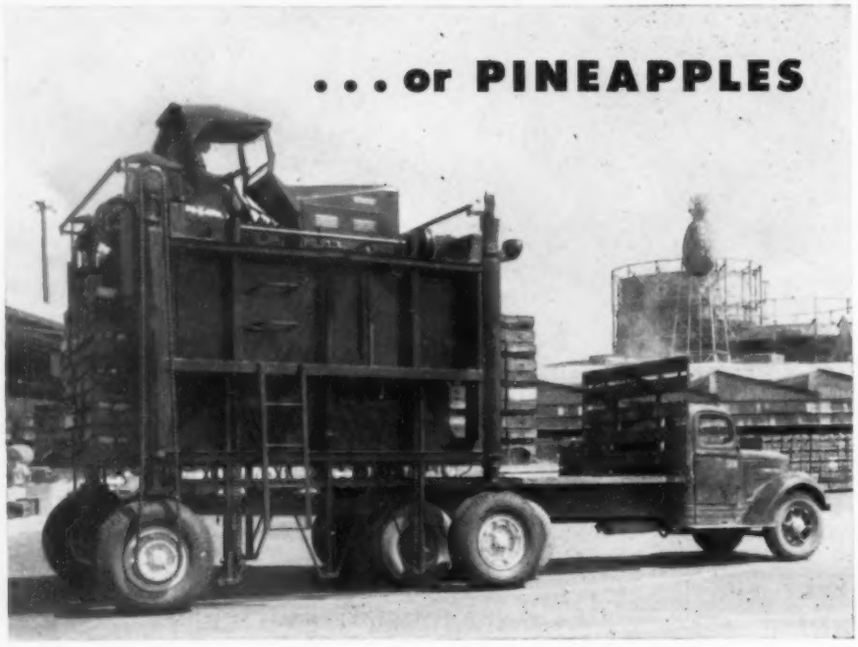
**Maybe your business isn't LUMBER . . .**

**. . . or PINEAPPLES**



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ROSS engineers will be glad to work with your materials handling men in exploring the possibilities of ROSS Straddle Carriers for your operations . . . there's no obligation.

Send for details on ROSS Straddle Carriers . . . 10,000 lb., 20,000 lb., 35,000 and 45,000 lb. capacities .

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**THE ROSS CARRIER COMPANY**

*Direct Factory Branches and Distributors throughout the world.*

**400 Miller St., Benton Harbor, Michigan, USA**

now being made indicate the cast HF material to have strength properties comparable to higher alloyed cast grades at these intermediate temperatures.

This development is a striking illustration of the fact that the same nominal composition in wrought and cast alloys does not mean that mechanical properties of each material are the same—frequently, they are quite different. This situation points up the necessity for using the ACI alloy designations in ordering castings, rather than the AISI type numbers (302, 304, etc.) which are associated with wrought materials only.

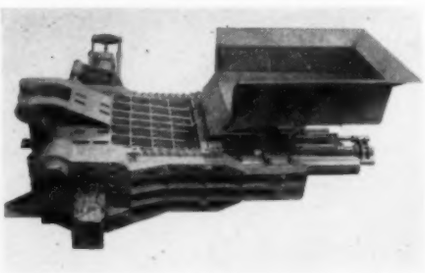
## SCRAP BALING PRESS

▲ High-capacity scrap baling presses built by Lindemann Maschinenfabrik, Duesseldorf, and extensively used throughout the world for more than 30 years, are now being imported into the United States by Kurt Orban Co., Inc.

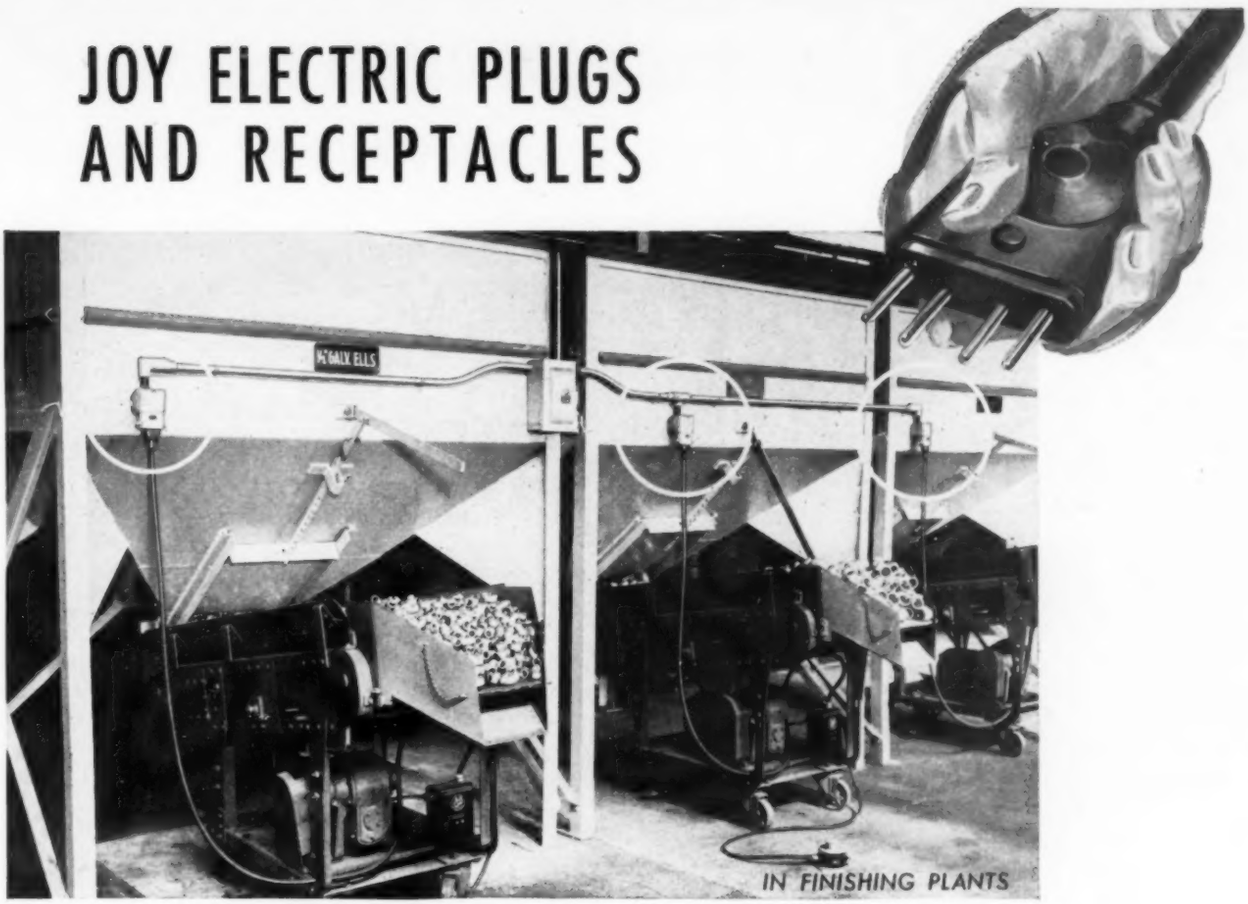
Two basic designs — the shearing ram type and the pressing-lid type— will be available in a wide range of models and sizes to meet the diversified requirements of the steel industry, the automotive industry, metalworking plants and scrap dealers.

The shearing ram type, "SE" series, is specifically designed for continuous feeding, and is readily adaptable to fully automatic operation. Scrap is fed into the press box, and two yoked half-pressure rams move forward to shear off any scrap above the level of the ram, and to effect the first compression. This sheared-off scrap remains on the cover plate of the half-pressure rams. Protruding pieces of scrap are cut off between blades, and the scrap is pressed into the chamber where it receives the final compression, after which it is ejected on to slide or conveyor belt.

**This pressing-lid type Lindemann scrap baling press (SA series) has triple compression with feed hopper for open hearth steel plants. Produces bales weighing up to 8800 lb at an output rate of 20 bales per hour.**



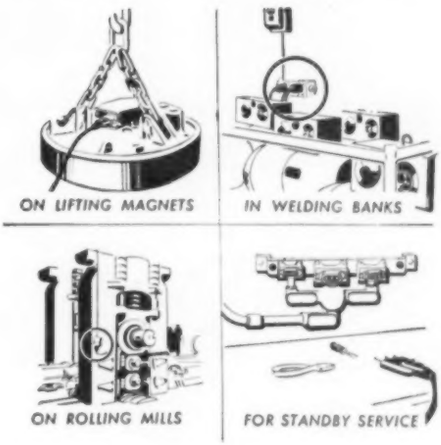
# JOY ELECTRIC PLUGS AND RECEPTACLES




# IN METAL PROCESSING PLANTS . . . STEEL MILLS ROLLING MILLS & FOUNDRIES

To earn the OK of Heavy Industry, electrical plugs and receptacles must function perfectly for long periods under conditions that quickly destroy many types now available for general industrial needs. That's our reason for believing the growing use of JOY connectors in metal processing plants, steel mills, rolling mills and foundries should be of particular interest to you. We're sure you'll want to know more about their inherent advantages (*see next paragraph*) before placing your next electrical connector order.

Factory molded to cable as one-piece Neoprene units, JOY connectors are little affected by rough handling, hard blows, grime, oil, moisture or vibration. Once installed, little or no maintenance is required. Available in designs and capacities to meet almost any portable power connecting requirement. Why risk electrical connector misfits when today's best actually costs less, in the long run. Full details including free literature available without obligation. Ask for them, today!




*Consult a Joy Engineer*

- ☆ *FACTORY MOLDED AS ONE-PIECE NEOPRENE UNITS*
- ☆ *SHATTER-PROOF, MOISTURE-TIGHT, WEAR-RESISTANT*
- ☆ *HIGHLY RESISTANT TO SUNLIGHT — OIL AND ACID*
- ☆ *EASILY INSTALLED — PROVIDE YEARS OF SERVICE*

. . . ***MORE THAN 100 YEARS OF ENGINEERING LEADERSHIP***

M. E. 1151.1

## JOY MANUFACTURING COMPANY

HENRY W. OLIVER BUILDING, PITTSBURGH 22, PENNSYLVANIA

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LTD., GALT, ONTARIO

Rams then return to their original position, and any sheared-off scrap on the cover plate of the half-pressure rams falls into the press box.

This type is equally well adapted to the preparation of old and new scrap in the yards of dealers and of steel plants, and to the baling of sheet iron scrap in automotive plants and other establishments where there is a continuous flow of scrap in large quantities.

Because of their shearing-ram action, the "SE" models combine the functions of a scrap shear and a baling press. Preliminary shearing or oxygen cutting of bulky scrap is eliminated in all cases.

Models for iron and steel scrap have bale capacities ranging from 80 to 950 lb with an output per hour from 100 for the smaller bales to 45 for the largest.

In all pressing-lid type models, the hydraulically-driven lid enters deeply into the press box, compressing the scrap from 60 to 75 per cent of its original volume, depending on the press model. At the same time, all scrap overhang is cut off between the lid edges and the rim of the press box.

In the "SO" series, particularly designed for ease and economy of use, the final compression is applied by a single horizontal finisher ram which also ejects the finished bale. Models in this series, with capacities up to 28 bales per hour and weights per bale of 290 lb are especially adapted for portable operation in the scrap dealer's yard.

The "SA" and "SI" series are of the triple-compression type and are provided with feed hoppers. The "SA" series is designed to cut baling costs at open hearth steel plants, and will produce bales weighing up to 8,800 lb at an output rate of 20 bales per hour. Size of feeding hopper allows complete filling for the next bale while the pressing operation is going on.

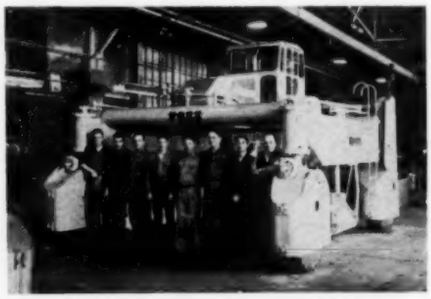
The "SI" series is intended for heavy-duty pressing of smaller scrap bales. They are adaptable to the requirements of blast furnaces, electric furnaces, motor car body works, large metal-working plants and large scrap dealer's yards. The smallest model produces 265-lb bales at rates up to 58 per hour; the largest, 800-lb bales at rates up to 52 per hour. In both the "SA" and the "SI" series, following the first compression by the lid, the second compression is exerted by the half-pressure rams, and the third compression by a final-pressure ram.

To assist American industry in the most effective and economical use of these scrap baling machines, Lindemann has stationed an engineer at Orban's New York office. He will supervise installations of the equipment, and will be available for maintenance service and for consultation on operation. Replacement parts for the Lindemann machines will be carried both at the Kurt Orban headquarters: 205 E. 42nd St., New York, and at the Orban Service Center, 4220 Prospect Ave., Cleveland 3, Ohio.

## HYDRAULIC CARRIER

▲ The largest capacity straddle carrier ever built, a Ross Carrier Co. Series 100, is solving the problem of transporting heavy, unwieldy loads of steel plate at Lukens Steel Co., Coatesville, Pa.

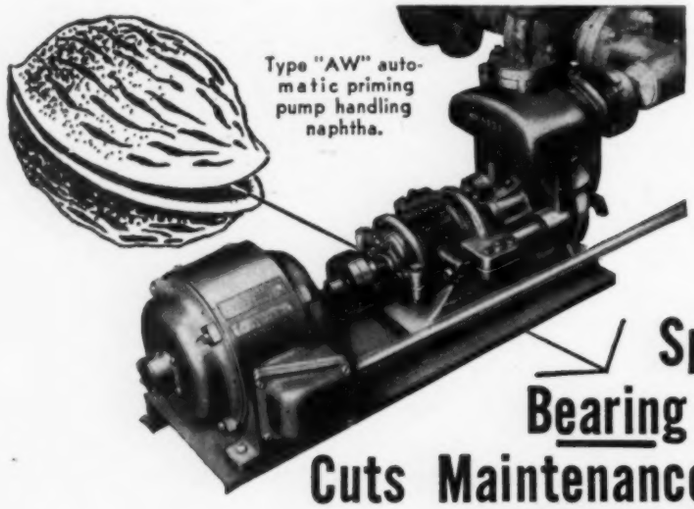
This huge machine is designed to handle loads 124 in. wide by 72 in. high, any length, and weighing up to



45,000 lb. Because it is self-loading and unloading, the carrier requires only a driver. Its flexibility of operation permits economies in time and manpower hitherto impossible. It is powered by a six cylinder 140 hp gasoline engine, has four-wheel hydraulic steering and four-wheel hydraulic brakes. Its load lifting mechanism is fully hydraulic for smooth, positive functioning.

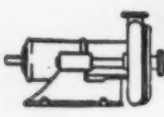
## NEW TYPE BEARING

▲ Roller Bearing Co. of America has announced the introduction of a completely new type bearing — "Pitchlign." These bearings have exactly the same dimensional advantages as precision needle bearings. They offer roller alignment formerly found only in precision cylindrical roller bearings and the ruggedness, flexibility of mounting, and easy maintenance of


Split Bearing Stand Cuts Maintenance Cost of NAGLE PUMPS

Just unscrew (or cut off with a torch if necessary) four nuts on each side and the top half of the bearing stand lifts off exposing the bearings. Merely loosen one nut on each side to release tubular supports, for slippage seal adjustment. Instant "thumb & forefinger" packing gland adjustment. Impellers, plates or casings changed in a jiffy. These and other features cut maintenance costs to the bone. That is why Nagle Pumps are preferred for the really tough pumping jobs. Also vertical shaft pumps for pumping abrasive or corrosive materials.



Nagle Pumps, Inc.

INDUSTRIAL PUMPS FOR ABUSIVE APPLICATION

1263 CENTER AVENUE, CHICAGO HEIGHTS, ILLINOIS

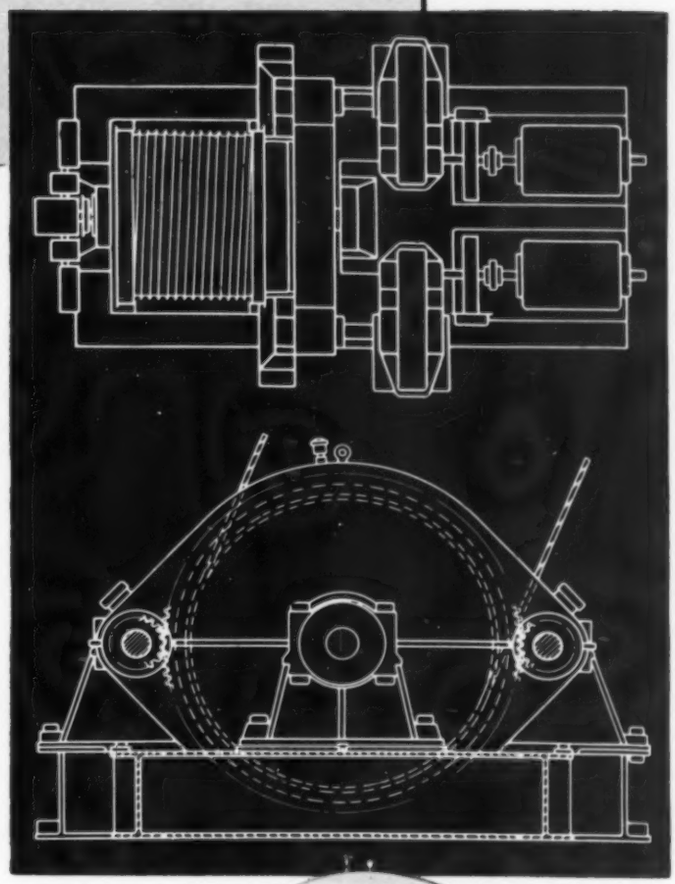
# *The* FREYN-DESIGN BLAST FURNACE SKIP HOIST *with*

*Symmetrically Arranged*

## Dual-Drive
(PATENTED)

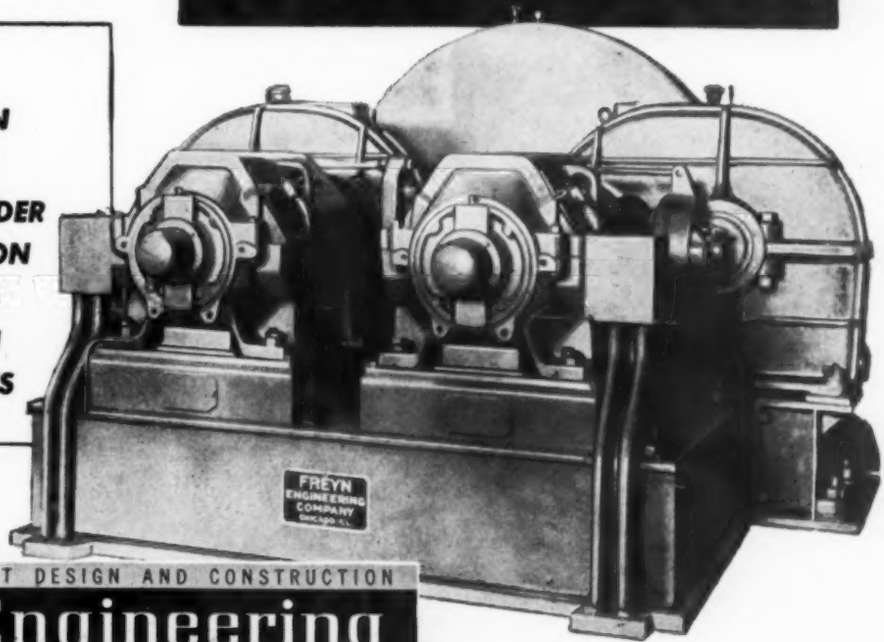
***is now the***

**RECOGNIZED STANDARD**



**12**

***FREYN-DESIGN SKIP HOISTS ARE NOW ON ORDER FOR INSTALLATION AT AMERICA'S MOST MODERN BLAST FURNACES***




METALLURGICAL PLANT DESIGN AND CONSTRUCTION

KOPPERS

**Freyn Engineering**

DEPARTMENT OF KOPPERS COMPANY, INC.

189 NORTH WABASH AVENUE · CHICAGO 2, U.S.A. Associated with Ashmore, Benson, Pease & Co., Stockton-on-Tees, ENGLAND
de Limon & Fouenel, Paris, FRANCE

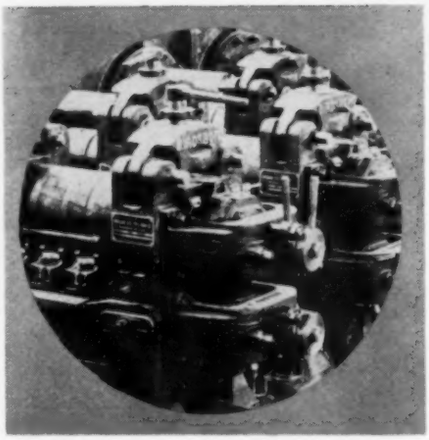
journal roller bearings. The bearing rollers cannot cock or skew! They are kept in perfect alignment by cage contact at their pitch line. This reduces stress and tangential forces to an absolute minimum. Overall efficiency of the cage is not affected by accumulated tolerances and wear of load-carrying surfaces, since it is supported by the two integral flanges of the heavy outer race.

The bearings can be mounted in any plane—horizontally or vertically—and are especially adapted for use on high speed shafts.

## FLEXIBLE END ROLL

▲ Birdsboro Steel Foundry & Machine Co. announces a new roller bearing end roll with features designed for flexibility, ease of adjustment, and a minimum amount of maintenance work.

Flexibility is achieved through the new totally enclosed bearing housing. This is locked to the end of the roll, but it may be changed in a matter of a few minutes from one roll to another, or it may be left in place on the roll during dressing, and thus need be changed only when the roll is discarded.



The bearing housing is held securely by heavy C clamps, and there is no point contact between the housing and clamp. Instead a self-aligning surface contact permits easy vertical adjustment without wear of the clamping surface. Vertical adjustment may be made freely without disturbing the axial adjustment, which is obtained through heavy adjusting nuts, graduated in one-thousandths of an inch.

Because there is no point contact between the clamps and the bearing housing, wear of the clamping point and indentation of the clamping surfaces is avoided. Further, the clamping surfaces may be freely set and locked, eliminating the resurfacing and grinding operation required with conventional locking devices to maintain clamping clearance. Maintenance is thus reduced to a minimum.

A patented tilting cap over the roll can be lifted to effect roll changes through the top of the housing without the necessity of disassembling the end roll adjustment, and with no loss in housing rigidity.

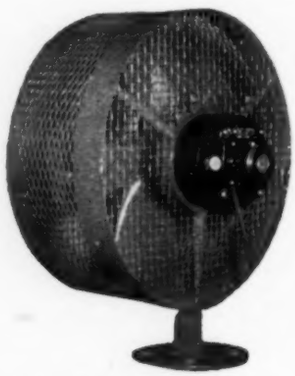
## TUBE PROCESS

▲ Yoder Co., after several years of experimental and test work, have successfully developed a machine for producing electrically welded tubing of the principal non-ferrous metals. These include practically all aluminum alloys available in coiled sheet form, copper alloys, various brasses, nickel, monel, inconel and stainless steels.

The process employed produces with high weld efficiency a tube comparable in quality to conventional re-

(*Please turn to page 195*)


*IS HEAT SLOWING UP YOUR WORKMEN?*



TRUFLO CRANE CAB FANS
For cooling interiors of crane cabs and other confined areas. Adjustable both horizontally and vertically. Four blade type, 12 and 18 in. sizes.

**Keep them COOL with TRUFLO FANS**

TRUFLO PORTABLE COOLING FANS
Easily portable. Help keep efficiency high where work is hottest. 12 to 36 inch diameters.

Production suffers when workmen are overheated. Steps begin to drag, efficiency falls.

Now, when speedy production is vital, Truflo Fans can help keep your workmen on their toes. All Truflo Fans are designed and built correctly to put fresh cool air *in large volumes* exactly where it is needed. Perfectly-balanced shafts and blades give more air per h.p. . . . strong steel frames stand up longer under hard use . . . rugged wire guards protect men against injuries.

All of the following types can help beat the heat, keep production moving in your plant. Write for illustrated literature.

PORTABLE COOLING FANS
CRANE CAB FANS • WALL FANS
EXHAUST FANS • BLOWERS
ROOF VENTILATING FANS
PENT HOUSE FANS

TRUFLO FAN COMPANY

245 MAIN ST., HARMONY, PA.

# TO A.I.S.E. SPECIFICATIONS . . .

Steel Mill Cranes whether built to individual mill or A.I.S.E. specifications, as shown here, are an important part of "Shaw-Box" production.

Built exactly to specifications and including the added advantages that come from "Shaw-Box" advanced engineering, construction details, and manufacturing processes, these cranes offer the greatest value in dependably superior crane performance your purchase dollar can buy.

The value and reliability of "Shaw-Box" Steel Mill Cranes, in maintaining production efficiency, is clearly demonstrated every day in mills all over the country.

Large facilities, modern equipment, and proven experience assure low production costs that are reflected in attractive prices.

*BE SURE TO SEND ALL YOUR INQUIRIES FOR STEEL MILL CRANES AND SOAKING PIT CARRIAGES TO "SHAW-BOX."*

## SHAW-BOX CRANES

MANNING, MAXWELL & MOORE, INC. MUSKEGON, MICHIGAN

Builders of "Shaw-Box" Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties. Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, and 'American' Industrial Instruments.

Dolomite Storage and Service Plant, United States Steel Company, South Works, Chicago, Illinois.

# WHAT'S YOUR PROBLEM?

When you have engineering and construction problems consult Roberts and Schaefer Company. Naturally, it's best to call R&S engineers during early planning stages — but it's a profitable decision *at any time*, whether your plans are started or not.

We do not claim to have all the answers, but we are willing to tackle your problem, as we have done for others in the past.

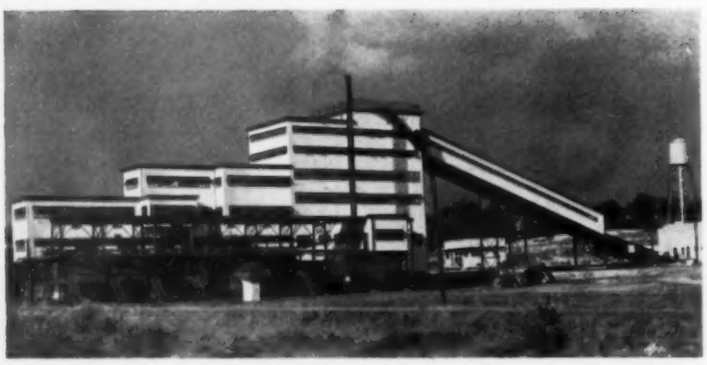
We are equipped to engineer and erect any plant for storing and handling bulk materials and processing them too.

For more than 50 years we have been engaged in this specialized type of engineering and have designed and erected complete plants for the mining, railroad and allied industries.

To our long list of installations for coal preparation, for storing and processing coal, coke, sand, and other bulk materials, we recently have added plants for coke breeze and dolomite. Then, too, our present research into the sintering and ore reclamation field might also interest you.

**Whatever your problem . . . phone or write us today — either at Chicago or one of our branch offices — no obligation, of course.**

Coke Breeze Storage and Service Plant, United States Steel Company, Gary Steel Works, Gary, Indiana.



Coal Preparation Plant, West Kentucky Coal Company, Madisonville, Kentucky.

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# Publication Service...



## You Can Obtain...

*... any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.*

### (1) Flow Valves

A new catalog is available describing adjustable flow valves for gas and air. Available in single or dual assemblies, and straight through or angle types, these valves are of real advantage in automatic flow control systems for gas or air. (713). Hauck Manufacturing Co.

### (2) Control Selection Bulletin

A new 8-page selection guide for a wide range of electric and electronic controls, devices, and accessories has been announced as available. The bulletin contains quick-reference selection data, photographs, and listings of additional publications which give complete information on each of the equipments. Products included are: manual, magnetic, combination, and reversing motor starters; push-button stations; relays; limit switches; solenoids; photoelectric relay; electronic timer; electronic relay; pressure and vacuum switch; float switch; pressure governor; reduced-voltage starter; Thy-motrol drive; and smoke density indicator and control. (GEA-5781). General Electric Co.

### (3) Crawler Crane

A catalog describing the new American crawler crane has been made available for distribution. The new catalog shows action views of the new crane. It points up the availability of interchangeable fronts—crane, shovel, dragline or pull shovel and lists overall specifications. This is the first catalog covering American Hoist's entirely new ¾-yard machine—the machine which heralds that company's formal re-entry into the crane and shovel market. (700-G-21). American Hoist & Derrick Co.

### (4) Mechanism of Rusting

"A Theory of the Mechanism of Rusting of Low Alloy Steel in the Atmosphere" is the title of a 38-page bulletin with 20 tables, graphs and photographs. Results from exposure tests on 71 low alloy structural steels exposed in industrial and marine atmospheres lead to new theory of the mechanism of rusting, which satisfactorily accounts for the improved corrosion resistance secured by the addition of nickel to steel. The author, H. R. Copson, research laboratory of International Nickel, was awarded the ASTM Dudley Medal for this paper. International Nickel Co.

### (5) Visible Records

"Kardlok", a signaling device for "Kardex" visible record systems, is the subject of a new booklet with graphic charting problems. The signals slide along a specially designed "track" and snap into the die cut slot corresponding with the desired figure and date on the visible margin of the record. Each signal is formed with two blisters, accurately spaced to fit into the oblong slots on the record card. The bulletin describes how the system can be used with various visible record systems for inventory control, production control, and personnel and installment records. (KD-680). Remington Rand, Inc.

### (6) Crane Cab Coolers

A complete line of crane cab coolers and conditioners is described in a new 24-page, illustrated bulletin now available. Designed to maintain comfortable working conditions and to supply clean, pure air under virtually all atmospheric and temperature variations, Dravo crane cab coolers and conditioners are now available in several models to meet every requirement. The bulletin points out that use of this equipment safeguards the health of crane operators and increases efficiency and alertness with resultant improvement in overall safety and production. Functions of the equipment include dust and dirt removal, fume and odor removal, winter heating and summer cooling. Included in the bulletin are complete specifications for the various models and suggestions on where and how to use them. Among the types of crane operation requiring coolers or conditioners are soaking pit, coil storage, open hearth ladles, forging furnaces, foundries, electric furnace, cupola, open hearth charging, pickling, aluminum reduction and smelting, copper smelting, annealing furnace, cement production, lead production, glass making, brass and bronze casting, steel and iron casting, galvanizing, and vanadium and manganese production. (1301). Dravo Corp.

### (7) Electrical Maintenance Service

A 24-page booklet describing a complete maintenance service for electrical apparatus can be obtained. The booklet presents a sound maintenance program based on the use of genuine renewal parts, repair service plants, and engineering and field service. Dozens of photographs show the special skill, testing devices, and repair equipment which are available to customers through strategically located repair plants. Many improved design renewal parts are illustrated to emphasize the importance of obtaining genuine renewal parts. Motor exchange service, periodic inspection service, and "on the spot" repairs by field engineers are also described. (B-4766). Westinghouse Electric Corp.

### (8) Bulk-Flow Conveyors

A new booklet of information on "Bulk-Flo" conveyors and elevators has just been published. This 28-page book contains photographs of the conveyors in a wide variety of applications, together with typical layout drawings, engineering data, calculation tables, charts and formulas. Over 150 materials are analyzed for average weight and such characteristics as size, flowability and abrasiveness. The conveyor was developed for the mechanical handling of a great variety of bulk flowable materials—granular, flaky, crushed, ground

or pulverized. The booklet shows views of typical applications handling coal, salt, lime, etc. The "Bulk-Flo" serves as a self-feeding conveyor or conveyor-elevator in one fully enclosed assembly. It consists of an endless chain with spaced solid flights in a close-fitting enclosure, for moving free-flowing materials gently in a continuous mass, in horizontal, inclined and vertical directions. (2475). Link-Belt Co.

**(9) Concrete Floors**

A new, completely illustrated, 20-page bulletin entitled "Traffic Concrete—A Study in Specialization" is available. The advantages of "Dynapakt" concrete floors are fully explained in terms of materials used and especially developed methods of installation. The high density, extremely hard topping is obtained by a process which depends upon proper material selection, proper formulation and power-driven installation equipment. The durable topping is long lasting because its extremely dense structure is uniform throughout the entire depth. A step by step comparison of "Dynapakt" low-water ratio methods, as opposed to wet mixes is included. Flash-Stone Co.

**(10) Anti-Rust Paint**

A new application bulletin containing information on the selection and use of anti-rust paints for all metal surfaces is announced. The new bulletin contains a description of the chemical properties of anti-rust paints and discusses the various methods of applying these paints in industrial, farm, home and marine uses. It also explains how and when to use colored finish paints over anti-rust paints. (L-4285). Paint Corp. of America.

**(11) Carbide Tools**

The publication of a new 4-page booklet is announced, which gives full details, particulars and prices on the new line of mechanically mounted "Klamp-Lok" tools with vertically clamped talide inserts recently developed. Outstanding features include talide inserts with multiple-sided cutting edges which can be removed for regrinding without removing the toolholder. (KL-52). Metal Carbides Corp.

**(12) Pipeline Strainers**

A new 4-page bulletin just off the press describes the complete line of Anderson self-cleaning pipeline strainers made in sizes from ¼ in. to 3 in. An interesting discussion titled "Value of Sediment Control" points out the numerous pieces of pipeline equipment needing strainer protection. These include steam traps, reducing valves, air tools, pumps, temperature regulators, etc. In addition, the bulletin contains complete specifications and prices on the product. Features discussed by the manufacturer include mesh type Anderson stainless steel strainer screen, low initial cost, self-cleaning feature when blow-down valve is used, and exceptional life. (252). V. D. Anderson Co.

**(13) Bin Level Indicators**

Just published is a new 1952 catalog describing and illustrating a complete line of bin level indicators which are widely used throughout industry to indicate the level of granular and pulverized materials stored in tanks, hoppers and bins. These units also actuate various types of signals, if required, and can be used to start and stop loading and filling machinery, as required by the level of content in the storage unit. The new catalog supplies complete installation data for the various types of units; for thin or thick walled bins, for inside or outside location, and for suspended interior installation. "Bin-Dicators" are available equipped with mercury switch, with sensitive micro switch for light materials, or with explosion-proof micro switch for use in hazardous locations. Numerous wiring diagrams are included making the book a useful reference manual for installation and maintenance crews. The catalog also describes a companion product, the "Bin-Flo" aerator unit, which is used to introduce low-pressure air into dry, finely ground materials which tend to pack and bridge, and thus restore their fluid characteristics. (BD-5). Bin-Dicator Co.

**(14) Temperature Controls**

Publication of a new 12-page illustrated catalog is announced which describes a complete line of temperature controls. Special features of this catalog are the additions of four new instruments and inclusion of tables of application and performance for all instruments. Covered is the use of these controls for temperatures from −300 to + 1800 F and in various severe applications. (G-17). Burling Instrument Co.

**(15) Smokeless Coke**

Recently published is a bulletin, entitled "Stilcok." The bulletin describes smokeless fuel, or coke, made in "Stils," in which the heating surface, radiator, or oven is inside the material by which means and method of heat application any carbonaceous substance may be distilled for recovery of its four base constituents, water, oils, gases and carbon residues, char, charcoal, coke, or "Stilcok." (Bulletin II). Stilcok Co.

**(16) Surface Tension Measuring**

A bulletin has been published describing the "Sur-Ten" meter, which is a new surface tension measuring instrument. It tells about a simple, practical device to enable anyone to make quick and accurate surface tension measurements under production conditions. Joseph B. Kushner, Electroplating Engineer.

**(17) Colloidal Graphite**

A new 4-page brochure contains photographs, diagrams, charts and information on the advantages of colloidal graphite over ordinary petroleum lubricants in the assembly and run-in of machines. The use of colloidal graphite, ordinarily as a dispersion in petroleum lubricants, results in smoother bearing surfaces, increased power from reduced friction, lower bearing temperatures and reduced oil consumption. It also provides shorter run-in period, protection against temporary failure of oil supply or rupture of oil film, less corrosion of cylinder walls and piston rings, fewer replacements and lower maintenance costs for bearings and friction surfaces, and longer useful operating life of engines and other machinery. Graphite particles in "dag" colloidal graphite are microscopic in size and electrically charged with the same polarity; therefore are mutually repelled and in constant uniform suspension throughout the carrier. A graphoid film on friction surfaces is finer, denser, more tenaciously adsorbed to the surface, and less liable to rupture than the films formed by conventional petroleum lubricants. (421). Acheson Colloids Co.

**(18) Thermistors**

A new 30-page catalog describing "Thermistors" is now available. The catalog contains general basic information relating to physical and operating characteristics of

"Thermistors," which are electronic semi-conductor control elements whose electrical resistance responds negatively to minute temperature changes. Typical applications and wiring diagrams are listed. Graphical data of temperature-resistance ratio characteristics for rod, disc and washer-types are included. Specifications, characteristics and typical applications are also given in the catalog. The last page of the catalog is devoted to suggested applications. (TH-5). Carboloy Department, General Electric Co.

### (19) Flexible Couplings

Everyone responsible for the continuous operation of machine tools, processing equipment, conveyors and other devices subject to temporary overload when something goes wrong, is aware of the time losses caused by sheared drive pins. At least fifteen minutes are lost in replacing sheared drive pins and putting a conveyor, for instance, back into operation. The Anchor-Waldron cut-out is an automatic, positive, mechanical, electrical and controlled device which instantly shuts off the motor when an overload occurs; it resets itself automatically. You simply push the starter button. If the overload has not been removed and the starter button is pushed the cut-out will again block the circuit and again reset itself. The resetting is automatic. Siren or light signals can be installed to give ample warning of the build-up in load before the danger point is reached. It is adaptable for a wide variation of horsepower, protects horsepower, eliminates down-time and saves on maintenance work. It is made in the flexible coupling type for direct connected drives as well as in the pulley type; it is totally enclosed, drip proof, dust tight, silent in operation, operates indoors and out, and in either a clockwise or counter-clockwise direction. Coupling torque range 10 to 2000 in.-lb. Pulley type unit torque range 20 to 10,000 in.-lb. (51). John Waldron Corp.

### (20) Cable Conveyor System

The successful application of overhead monorail cable conveyor systems to heavy duty, as well as lightweight materials handling purposes, was recently reported in a bulletin available to you. The use of 9/16 in. steel core cable in joining trolley brackets was accomplished with complete satisfaction, according to that firm's engineers. This was made possible by the Daigle-Gaboury development of the "split" nut and trolley bracket assembly. In this system, the cable passes through the "sleeves" of the "split" bracket. The "sleeves" have internal serrations. Externally, they are tapered in shape and threaded. When the cable is enveloped by the bracket "sleeves," the halves of the "split" nut are then brought together on the "sleeve" and turned on the expanding threads of the taper. In this way the nut exerts a 360 degrees compression on the "sleeve" causing it to establish a biting hold on the cable with its internal serrations. It is stated that in this fixed position on the cable, trolley brackets withstood "pull loads" up to 10,800 lb without indications of slipping. Daigle-Gaboury, Inc.

### (21) Portable Conditioners

Revised literature which incorporates a description of the new air cooling feature of Fageol heat machines is announced. The new six-page bulletin, printed in red and black, describes how the Fageol Model PW-189 can be converted in five minutes' time from a 189,000 Btu portable heat machine which efficiently heats a 6-ft-high work zone, to a 1500 cfm cool air circulator which provides comfortable air conditioning in summer. (L-5391). Fageol Heat Machine Co.

### (22) Steam Generator

A new 28-page bulletin especially prepared for engineers, consulting engineers and architects for their guidance in understanding the advance design features that distinguish the preferred unit steam generator from other unit steam generator types is available. The bulletin describes the engineering differences of the component features of the self-contained preferred unit steam generator which permit economical service for an average life of 25 years. Numerous illustrations of the components and the unit including cutaway views for easy visual references supplement the descriptions. As shown, these features developed from years of research and developmental work include staggered tubes, four-pass gas travel construction, anti-stress deck, expansile precipitator, induced draft, and horizontal rotary oil burner. Combination gas and oil-fired unit is also described. Preferred units can be fired by light oil, heavy oil, natural and manufactured gas. (2000). Preferred Utilities Manufacturing Corp.

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IRON & STEEL ENGINEER

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MAY, 1952

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IRON & STEEL ENGINEER

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| ITEM | COMPANY | BULLETIN | DESCRIPTION |
|---|---|---|---|
| 50 | ALDRICH PUMP CO. | DATA SHEET 61-2 | Describes several types of Aldrich spray nozzles. |
| 51 | AMERICAN BRAKEBLOK DIVISION, AMERICAN BRAKE SHOE CO. | | Folder available on "A-B-K" roll neck bearings. |
| 52 | BLISS CO., E. W. | | 52-page brochure on mill accessory equipment. |
| 53 | BRISTOL CO. | | Bristol thermocouple and pyrometer accessories. |
| 54 | BRISTOL CO. | | Catalog giving details on "Dynamaster" performance. |
| 55 | BROWNING AND CO., INC., VICTOR R. | BULLETIN "E" | Describes Browning mill type cranes. |
| 56 | CLEVELAND QUARRIES CO. | | Literature available on Buckeye silica firestone. |
| 57 | DRAVO CORP. | | "Dravo Crane Cab Coolers and Conditioners." |
| 58 | ELECTRIC CONTROLLER & MFG. CO. | BULLETIN 1032 | Describes the Youngstown safety limit stop. |
| 59 | ELECTRIC PRODUCTS CO. | BULLETIN 2-200 | Custom-engineered a-c and d-c motors and generators. |
| 60 | ELECTRIC SERVICE MFG. CO. | | 4-page folder on Keystone aluminum conductor system. |
| 61 | FARMERS ENGINEERING & MFG. CO. | BULLETIN 25 | Describes "Femco" trolleyphones. |
| 62 | FARREL-BIRMINGHAM CO., INC. | | Bulletins available on cost-reducing roll grinders. |
| 63 | FOOTE BROS. GEAR AND MACHINE CORP. | BULLETIN LPB | Foote-Bros. "Line-O-Power" drives. |
| 64 | FOXBORO CO. | DATA SHEETS 831-1 AND 833-2 | Gives information on metering and measuring equipment. |
| 65 | FURNACE ENGINEERS, INC. | | Bulletin covering all types of F.E.I. heat treating furnaces. |
| 66 | GENERAL ELECTRIC CO. | BULLETINS GEA-5618, 5622 AND 5512 | Magnetic loop control; x-ray thickness gage; and tensiometer. |
| 67 | GULF OIL CORP. | | Gulf E.P. lubricants. |
| 68 | HOMESTEAD VALVE MFG. CO. | | Catalog on all types of plug valves. |
| 69 | KOPPERS CO., INC., FAST'S COUPLING DEPT. | | Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs. |
| 70 | LESLIE CO. | | Illustrated bulletin on Leslie floatless level control. |
| 71 | LOVEJOY FLEXIBLE COUPLING CO. | | Complete catalog and quick-finding selector charts on flexible couplings. |
| 72 | LUBRIPLATE DIVISION, FISKE BROTHERS REFINING CO. | DATA BOOK 1-52 | Describes "Lubriplate" lubricants. |
| 73 | NATIONAL CARBON CO. | BULLETIN CP-2444 | Complete list of "National" mill motor brushes built to AISE standards. |
| 74 | OAKITE PRODUCTS, INC. | FOLDER F&642 | Oakite "CrysCoat" process. |
| 75 | OKONITE CO. | BULLETIN IS-1053 | Describes "Okolite-Okoprene" cables. |
| 76 | PITTSBURGH LECTROMELT FURNACE CORP. | CATALOG 8 | Iron and steel melting and refining work. |
| 77 | POOLE FOUNDRY AND MACHINE CO. | | Catalog gives full description and engineering data. |
| 78 | RELIANCE ELECTRIC AND ENGINEERING CO. | BULLETIN B-2201 | Reliance pre-lubricated bearing design. |
| 79 | SPRAYING SYSTEMS CO. | DATA SHEET 3997 | Spraying systems descaling nozzles. |
| 80 | TRUFLO FAN CO. | | Illustrated literature available on Truflo fans. |
| 81 | UNITED STATES GRAPHITE CO. | | 40-page catalog gives complete information on standard USG grades. |
| 82 | WAGNER ELECTRIC CORP. | BULLETIN MU-132 | Gives complete information on corrosion-resistant motors. |
| 83 | WESTINGHOUSE ELECTRIC CORP. | BULLETIN B-4695 | "Westinghouse Equipment for Arc Furnaces." |
| 84 | WESTINGHOUSE ELECTRIC CORP. | BOOKLET B-4730 | Describes Westinghouse mill motors. |
| 85 | WESTINGHOUSE ELECTRIC CORP. | BOOKLET B-5457 | Westinghouse safety switches. |
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For the final, exacting reductions of aluminum, Lewis Foil Mills are proving their value in many mills. These new high-speed mills "roll it out" at 4000 feet per minute with extreme accuracy and non-stop performance. Why not take advantage of the valuable technical experience available at Lewis for rolling all types of ferrous and non-ferrous metals?

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# The light in the "Lab"

In the research laboratories of hospitals, clinics, and medical schools throughout our country, the lights burn late . . . as scientists constantly strive to halt humanity's greatest enemy—CANCER.

As the lights continue to burn, the hope for a cure grows brighter . . . here's why:

## Cancer Research Is Paying Off

Through research—which you have helped to support by donating to the American Cancer Society—medical science now has new weapons to combat this disease more effectively than ever:

**Drugs**—there is evidence that a chemical treatment for cancer may be perfected. Certain drugs will prolong the lives of cancer victims . . . other promising compounds are being tested.

**Hormones**—treatment with hormones, such as ACTH and Cortisone, has brought about dramatic, although temporary, effects in some types of cancer. Other hormones have helped control *advanced* cancer of certain organs.

**X-rays**—the development of more powerful machines promises to make this form of treatment more effective.

**Isotopes**—radioactive chemicals are becoming increasingly useful in treating certain rare forms of the disease.

In addition, surgical technics have been improved so much that once hazardous operations can now be performed safely. And progress is being made in the development of tests to detect cancer in its earliest stages when the chances for cure are best. Research has made these life-saving advances possible. But, as long as cancer continues to kill some 210,000 men, women, and children in our country each year, we *must* keep the lights burning in the laboratories! *Much more research needs to be done before cancer can be dealt the final blow!*

Your life—the life of everyone you know—is at stake. Give generously to the 1951 Cancer Crusade.

**Help Science Help You . . . Give To Conquer Cancer**

Mail your contribution today to CANCER c/o Your Local Post Office

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(*Continued from page 186*)

sistance-welded steel tubing. At present Yoder is offering three sizes of mills which have a total capacity range of ¾ in. to 8 in. diameter, on metal thicknesses ranging from .025 in. up to .140 in.

Welding speeds of 50 to 90 fpm are practical. This represents an increase of 1,000 per cent or more over previous methods of welding these alloys, with a generally superior weld quality.

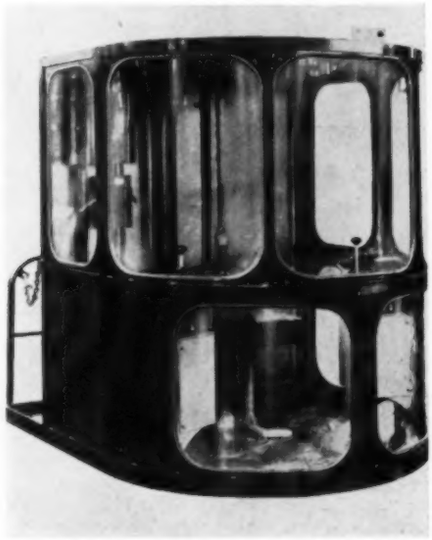
Several companies in the aluminum and copper industries have already placed orders for this equipment.

## PLASTIC SAFETY WINDOWS

▲ Windows for the cabs of Harnischfeger cranes and excavators are now being glazed for maximum clarity and safety with "CR-39" cast plastic sheets (allyl diglycol carbonate), the product of Cast Optics Corp.

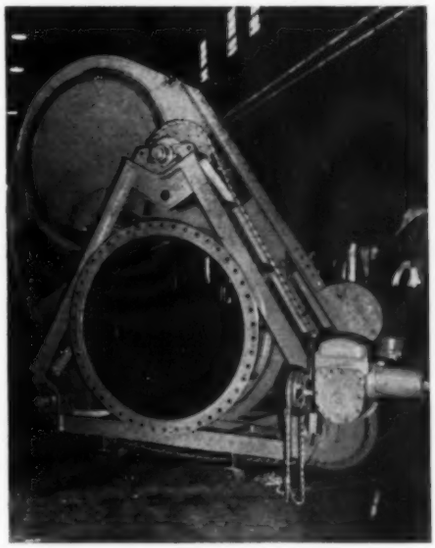
According to the manufacturer, the new cab windows are as clear as plate glass, their light transmission factor being 92 per cent. Clear vision for the operator is further assured by complete resistance of the new cast plastic to both mechanical and chemical crazing, plus 30-40 times the resistance to abrasion of the (acrylic) plastic windows used previously.

Whether cranes are used indoors or out, safety of the operator is made doubly sure by the high resistance of these plastic sheets to impact, chemical action, and the spatter of molten metals. Toughness (resistance to impact on the notch test) is 0.35 ft lb/in. Chemical resistance is complete for alkalies and caustics, organic solvents, and all but the oxidizing acids. Resistance to molten metal spatter is proved by the almost universal use of plastic as "1000-hour" cover glasses on welding helmets.



## PUSH-BUTTON VALVES

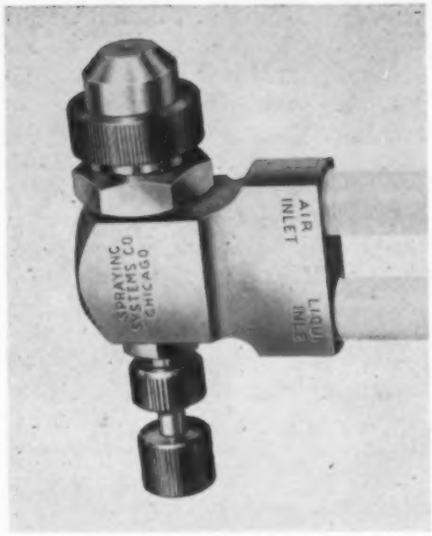
▲ Electrical operation and push-button control is a new feature added to the Brosius - Westling goggle - type plate valves for large diameter blast furnace and coke oven gas mains. The new type valve announced some months ago by Salem-Brosius, Inc., now has incorporated into its design two heavy-duty electrical units that control and operate both the plate swing in the valve and the opening and closing of the valve proper. This assures easy operation, sure closing, and positive positioning of the valve in all sizes ranging from 36 to 108 in. diameter. Operating on 220-330 or



440-550 volt plant power, the new unit has a speed reduction of 170:1, a running output torque at 10 rpm of 425 ft-lb, and a built-in hammer blow arrangement for loosening parts set by scale or rust.

## SPRAYING NOZZLE

▲ A new pneumatic atomizing nozzle has just been announced by Spraying Systems Co. with both air and liquid inlets positioned at the top of the nozzle body, at right angles to the direction of spray. Identified as the "⅛ JACN," this new pneumatic atomizing nozzle design solves many special mounting problems. The unit illustrated is supplied with shut-off needle. The same design nozzle is also available without shut-off needle.




Capacities of these nozzles and the types of spray are determined by the fluid and air nozzle assemblies. A wide range of these assemblies or set-ups are available to provide pressure or siphon set-ups with round, wide angle round and flat sprays.

## INDUSTRIAL BATTERY

▲ The life of industrial storage batteries used for railway, motive power and other heavy duty service, will be prolonged by six outstanding improvements in the Exide-Ironclad storage battery, including a new silver alloy grid metal, and a non-corroding permanent positive-plate tube sealer.

Corrosion of the positive-plate grid is one of the leading causes of battery failure. Introduction of a new alloy, silvium, in the construction of the positive-plate grid of the improved battery, reduces the corrosion factor and assures a longer positive grid life. Silvium is an alloy of silver, lead and other components and is highly resistant to corrosion.

Another cause of curtailed battery life, which has always plagued storage battery manufacturers, is the loss of the active material from the positive plate. When it becomes sediment in the bottom of the cell it represents lost capacity and reduction in battery life. There also is the threat of possible trouble from short circuits within the battery caused by an accumulation of loose active material.

A solution for this problem has been the constant goal of battery research. Through the years there have appeared various methods for holding this active material in place.

By far the most efficient method

of active material retention is unique with the Exide-Ironclad positive plate. The grid is made up of metal core rods which are inserted in slotted hard rubber tubes. Active material is then packed into the tubes surrounding the rods. The slots in the tube permit free access of the electrolyte to the active material, but they are fine enough to prevent it from washing out.

The bottoms of the tubes were formerly sealed with an alloy bar. After considerable service life, however, corrosive action on this metal bar closing the tube bottoms would eventually breach the seal. Active material would then seep out and be deposited in the bottom of the container.

After extensive research, a far superior replacement was found for the metal bar. Molded in a single bar of polyethylene, a plug for each tube projects to effectively and permanently seal it at the bottom against loss of active material.

The new tube sealer is permanent because it is non-corroding, and is unaffected by the electrolyte or electrolytic action, thus holding its shape and remaining intact. The importance of this to the user is that high capacity is retained for a longer working life because the active material is held in place in the tube.

In addition, polyethylene is an insulating material. Extending across the entire bottom of the plate, it acts as a safeguard against shorting between plates. The elimination of metal at the bottom of the positive plates assures better negative plate performance because of low local action and the reduction or elimination of shedding of active material.

## POLE-TYPE TRANSFORMER

▲ The fourth weight reduction in General Electric distribution transformers since 1937, brought about by a new design of the pole-type units, has been announced by the company's distribution transformer department in Pittsfield, Mass.

The new design, which ranges from 5,000 volts to lower voltages, reduces over-all weight approximately 10 per cent and saves critical materials. The weight reduction will make installation of pole type transformers easier, saving installation time and expense.

Improvements in core steel and processing methods have been incorporated into the design. A reduction in the use of copper has made it possible to build seven transformers with the same amount of the metal formerly required for six.

In addition to its stronger construction, the new transformer offers lower impedances and improved regulation. Clamping structures and coil supports have been simplified, materially increasing short-circuit strength.

The new units are available in ratings of 50 kva and less, other ratings will be added as soon as practicable.

## GAS SCRUBBERS

▲ Nine new "scrubbers" are being installed to wash blast furnace gas at Duquesne, Pa., works of United States Steel Co. R. W. Graham, general superintendent of the plant, said the new installation will greatly re-

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If you want to materially reduce down time on rolling mills due to clogged nozzles, try Spraying Systems descaling nozzles. Large orifice diameter permits passage of practically all particles that ordinarily clog other types of nozzles. Spraying Systems nozzles produce an effective uniform flat spray, free of streaks, with an impinging force equal to over 96% of the maximum potential. Typical user is the Homestead District Works of U. S. Steel illustrated above. Nozzles are made of hardened stainless steel in a wide range of capacities and spray angles. Your inquiry is invited . . . write for Data Sheet 3997.
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Also write for Data Sheet 4516 . . . Pneumatic Atomizing Nozzles for direct spray gear lubrication.

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# BRISTOL

*The dependable Guidepost of Industry*

**AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS**

**THE BRISTOL COMPANY**
**123 Bristol Road**
**Waterbury 20, Conn.**

Please send free book on Bristol Thermocouple and Pyrometer Accessories.

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duce the dust content of the furnace gases.

The 80-ft high washer cylinders are shaped like household hot water tanks. Twelve ft in diameter, they are tailored to handle one of the biggest "washings" in Allegheny County. In an around-the-clock operation, they will "scrub" every minute about 330,000 cu ft of gas emerging from the six Duquesne blast furnaces.

Inside the washers, a water spray is diffused through stainless steel screens, and the washed gas is recovered to fuel the plant's boilers. The operation also recovers valuable iron ore dust which is then processed in company sintering plants and used as part of the blast furnace charge, conserving iron ore that is shipped in from Minnesota.

U. S. Steel's American Bridge division is handling the "scrubber" installation, which is expected to take about one year to complete.

## ELECTRICAL DRIVES

▲ More than $2½ million worth of General Electric's equipment, including drives totaling 14,300 hp, is being installed as part of a new five-stand tandem cold-strip steel mill at the Kaiser Steel Corp.'s Fontana, Calif., plant.

The third of its kind to be built on the West Coast, the new mill will help meet the ever-increasing demands of the booming California canning industry.

With a rated top speed of 4100 fpm, it will cold-roll tinplate up to 38 in. wide. Five motors, ranging from 1500 to 3500 hp, will drive the five stands of the mill and the reel will be driven by an 800-hp motor. Electric power for the various motors will be furnished by two motor-generator sets with ratings of 5600 kw and 5840 kw respectively.

General Electric is also furnishing complete electrical equipment for a continuous electrolytic tinning line and a tinplate shearing line.

Other G-E equipment includes three 3750-kva transformers; motors and generators for a coil preparation line, cleaning line, pickle line, and six hot-dip tinning lines; eight 750-kva load center unit substations; a 50-kv x-ray thickness gage; two 500-kw rectifiers; controls, switchgear, tensiometers, and other auxiliary apparatus.

## METAL MARKER

▲ This extra duty, fully pneumatic marking machine is the newest addition to the Jas. H. Matthews & Co. series of 204 marking machines. It has been designed to fill the need for a unit to impress an extra deep mark on tough metal surfaces without exerting extreme pressures and shock to the parts being marked and the marking dies; or where the parts are of such design that they will not withstand the necessary pressure required to make the mark in one pass.

Operation of the unit is simplicity itself. Keeping the control switch at the side of the machine at "Reciprocating Position," the operator depresses the foot control pedal, which brings the table holding the part to be marked into marking position. After a timed interval (normally a fraction of a second), the head of the machine will automatically pass the marking die back and forth on the part being marked, until the foot control pedal is released . . . deepening the mark with each pass. To compensate for the additional depth of the mark with each stroke of the reciprocating head, the elevating


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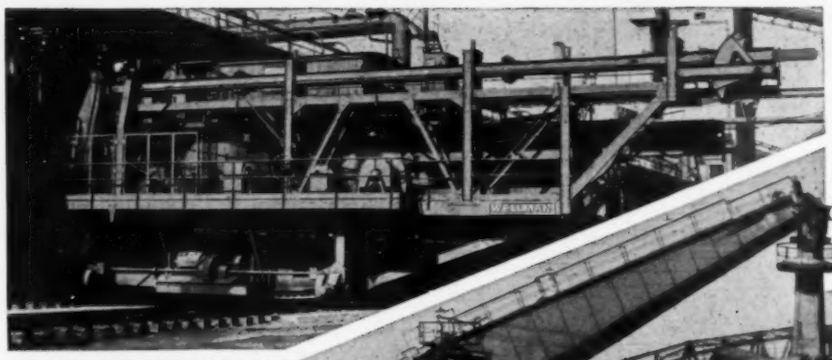

Top—*Wellman Coke Pusher at the Lorain Works.*

Center — *One of two Wellman 20-ton Hulett-Type Ore Unloaders at the Lorain Works.*

Bottom — *Three Wellman 12-ton Low-Type Open Hearth Charging Machines at the Lorain Works.*

# How Wellman serves the Lorain Works

● These pictures show three important applications of Wellman equipment at the Lorain Works of National Tube Company. These installations are typical of the contributions which Wellman has made to the steel industry for more than 50 years.

Wellman is recognized the world over as a pioneer and leader in the engineering, manufacturing and installation of heavy duty machinery for the steel industry. We welcome your problems.

**THE WELLMAN ENGINEERING COMPANY**

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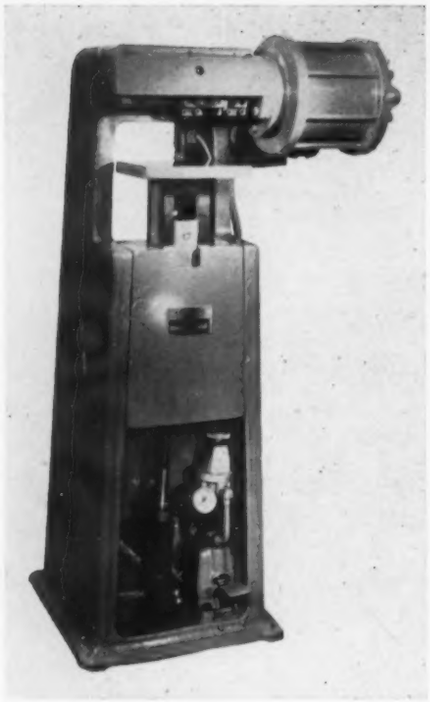


table holding the part is kept under a constant "air cushion" adjustable up to six thousand pounds maximum pressure.

By merely throwing the control switch to "Standard Position," thus cutting out the automatic reciprocating operation of the micro-switches on the machine head, the machine combines the marking possibilities of the other "204" models, enabling it to mark a part with a single stroke of the marking head.

Round parts to be marked are held in a cradle roll fixed to the elevating table. Suitable gages are made to hold flat parts in position during the marking operation.

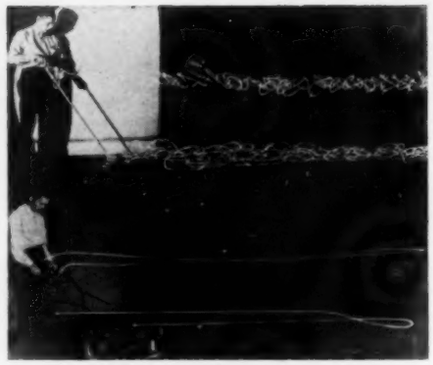
## MECHANIZED SWEEPER

▲ Time and motion studies on industrial sweeping methods verified by the illustration have uncovered alarming areas of waste where hand methods are still used.

The top picture shows the vast amount of motion wasted by a maintenance man while sweeping just 3000 sq ft an hour.

The lower photograph shows the ease with which 15,000 to 22,000 sq ft can be swept clean and the debris collected in one hour by the same man using a modern motorless sweeper, with absolutely no wasted motion, or extra steps.

"Plantman," a sweeper being marketed by Handling Devices Co., Inc., is the device which has been proved especially economical where passageways are at least 30 in. wide and where a minimum of 7500 sq ft of floor space or outside area exists to be cleaned.



Definite time and motion studies, therefore, have clearly demonstrated that the sweeper will sweep and collect in an hour five to seven times the area that can be swept by conventional hand methods. The hopper collects everything from paper to coke bottles and never gets too heavy for one man to lift. Light and portable, this sweeper saves in one effortless operation 87 per cent of the time exhausted by using other methods.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Can you clean steel and condition it for painting for less than 20 cents per 1,000 square feet?

WITH minimum equipment . . . in minimum time . . . at minimum cost . . . the OAKITE CrysCoat PROCESS* cleans metal surfaces and prepares them for painting . . . prevents corrosion before and after the metal is painted. *Reg. U. S. Pat. Off.

**FREE** Write to Oakite Products, Inc., 19 Rector St., New York 6, N. Y., for Folder F7642. This 8-page illustrated leaflet describes 19 advantages of the OAKITE CrysCoat PROCESS and lists 10 ways in which it cuts the cost of cleaning and preparing for painting.

**ALSO** *ask about Oakite procedures for:*

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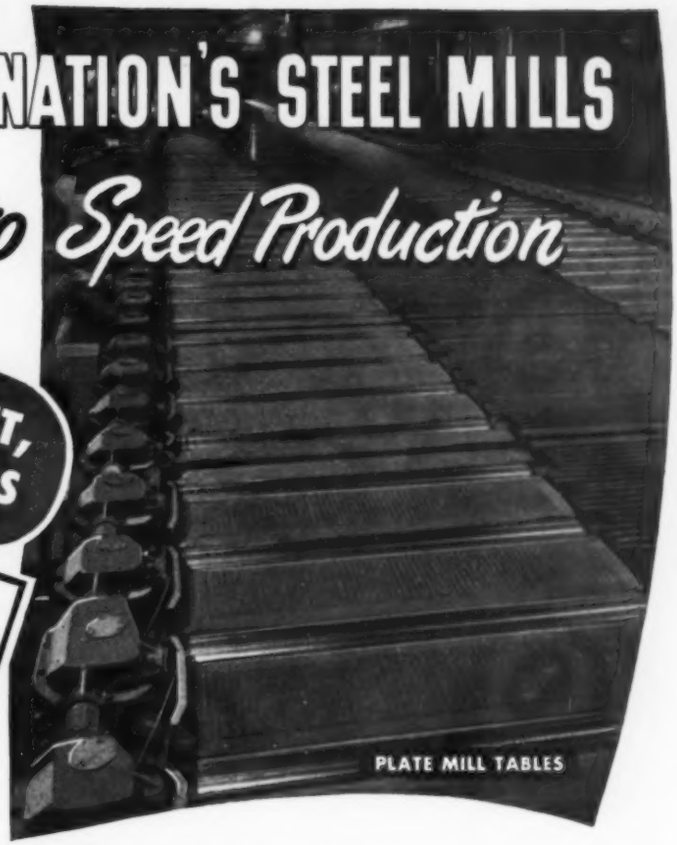


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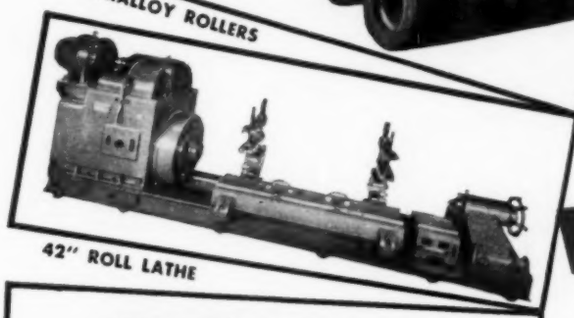
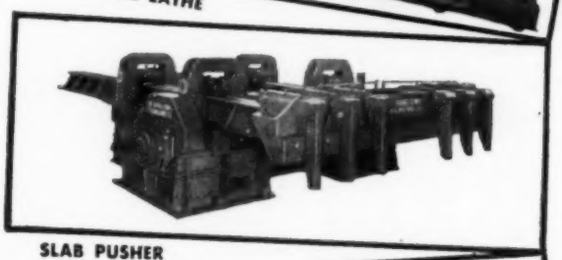
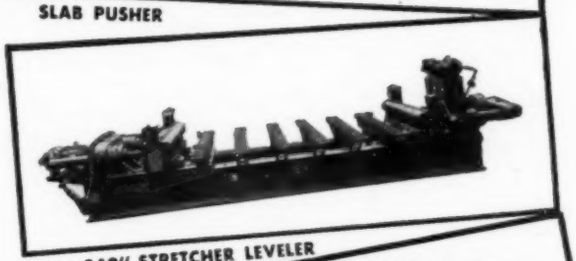
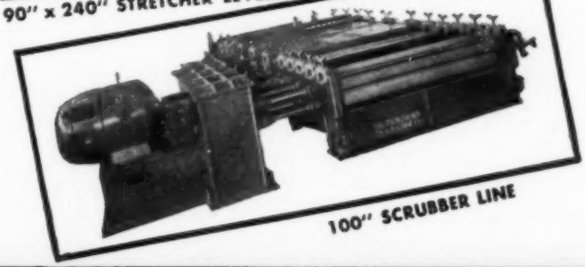

42" ROLL LATHE


SLAB PUSHER


90" x 240" STRETCHER LEVELER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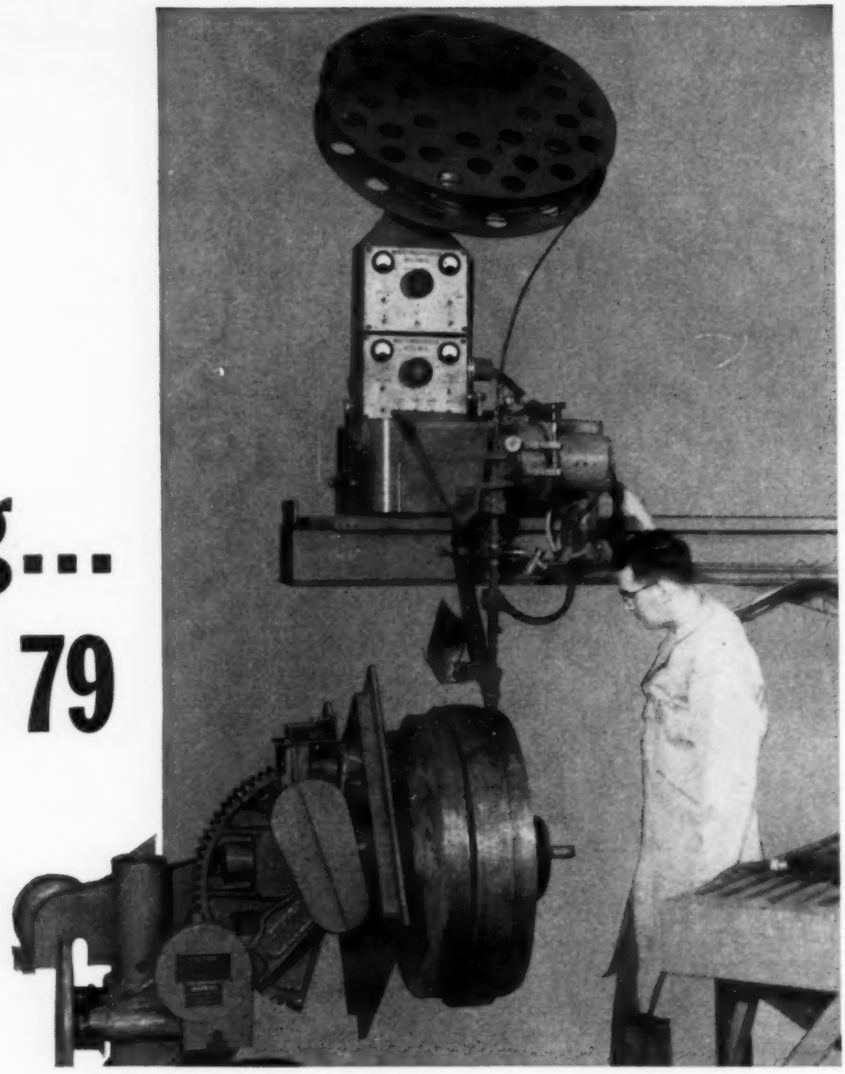

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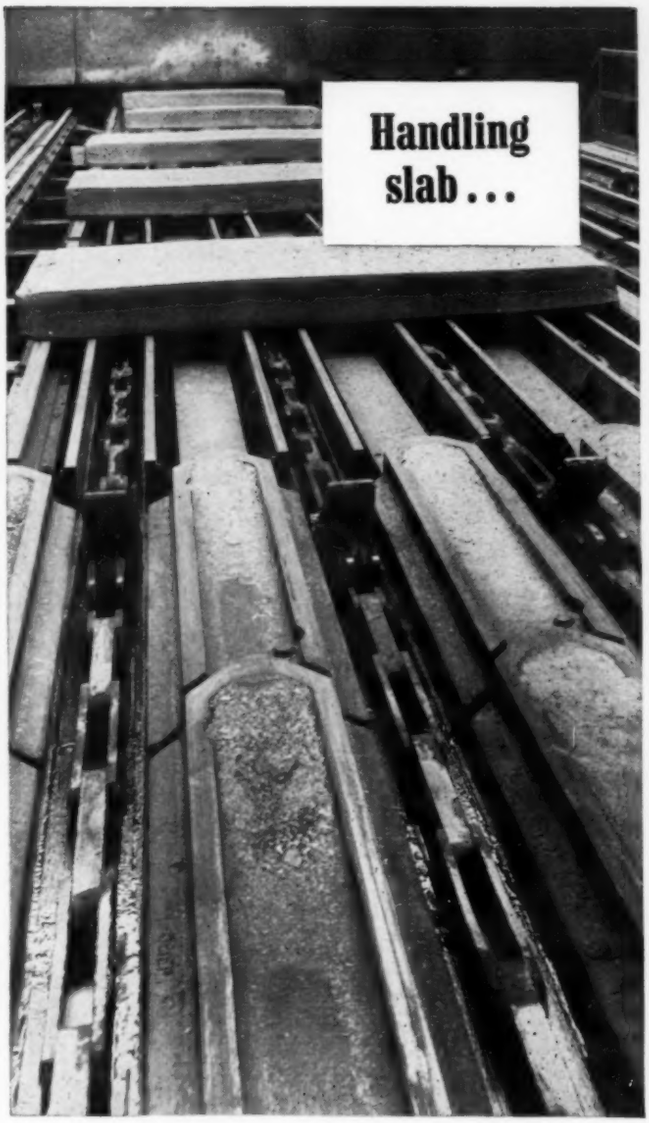


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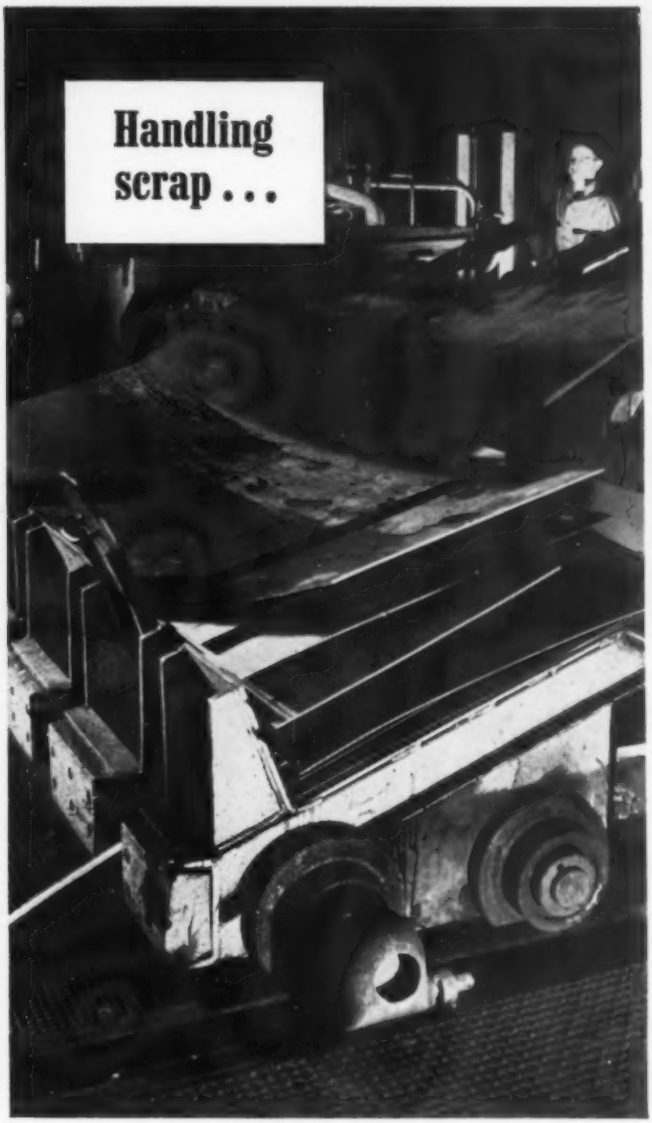


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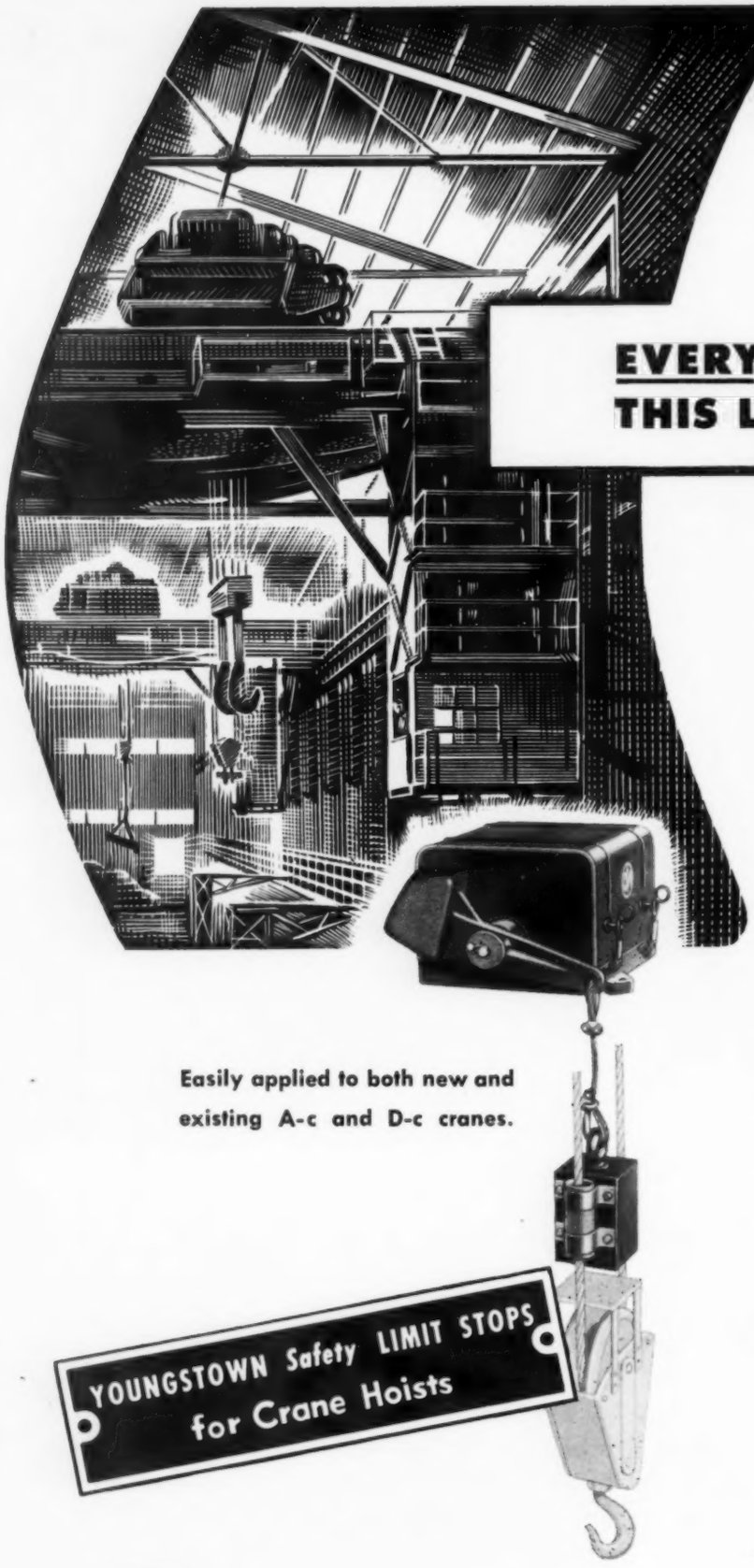

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Wagner Cast Iron Frame Motors are designed to provide the corrosion resistance demanded by applications in chemical plants or in other applications where protection against corrosion is required. They feature completely protected laminations . . . special varnish treated windings . . . a cast iron, gasket-sealed conduit box . . . a running shaft seal . . . and are totally-enclosed and fan-cooled for complete protection against acids and alkalies present in the atmosphere in the form of dust, fumes or moisture. The photo at right illustrates the rugged, one piece cast iron frame, showing openings for ventilation.

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M52-10

# Farval helps McKay handle tough plate leveling jobs

FLATTENING heavy steel plates is always a tough job. The rollers that do the leveling and the bearings on which they run are built to take plenty of punishment.

To keep all bearings on its levelers functioning smoothly and efficiently, McKay employs Farval Centralized Lubrication. In fact, Farval has been standard equipment for many years on all the roller levelers and many other types of machines this company manufactures.

Farval assures that every bearing regularly gets the exact, measured amount of lubricant it requires. Special oilers are not needed, lubricant consumption is reduced, bearing life is extended indefinitely and shutdowns for oiling or bearing replacement are eliminated. In short, with Farval on the job, the purchaser of a McKay leveler is insured of getting all the value built into the machine by its manufacturer.

Farval is the original Dualine system of centralized lubrication for industrial equipment, proved practical in 25 years of service. The Farval valve has only two moving parts—is simple, sure and foolproof, without springs, ball-checks or pinhole ports to cause trouble. Through its full hydraulic operation, the Farval system unfailingly delivers oil or grease to each bearing—as much as you want, exactly measured—as often as desired. Indicators at all bearings show that each valve has functioned.

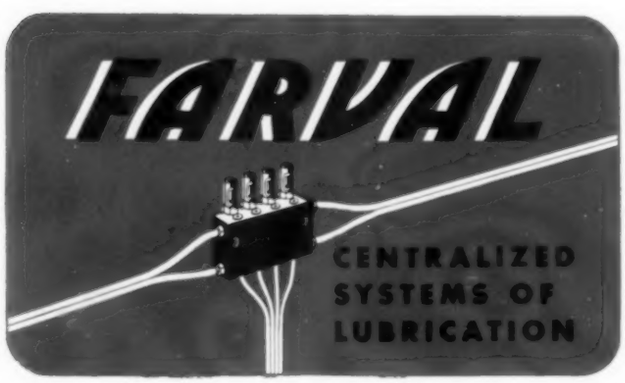
In or near your city there's a Farval engineer, ready to discuss your lubrication problems and suggest a proper system to meet your particular needs. The Farval Corporation, 3278 East 80th Street, Cleveland 4, Ohio.

*Affiliate of The Cleveland Worm and Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.*

FARVAL—*Studies in Centralized Lubrication* No. 129

KEYS TO ADEQUATE LUBRICATION—*Whenever you see the sign of Farval—the familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated. Farval manually operated and automatic systems protect millions of industrial bearings.*

Photo above by courtesy of The McKay Machine Company.



**AT JONES & LAUGHLIN STEEL CORP.** in Pittsburgh, G-E Magnetic Loop Control helps maintain pickling-line speeds up to 400 fpm. G-E control panel behind operator is for line in rear. Strip in foreground has just emerged from another G-E controlled line.

# Strip tonnage raised by closer control of position, thickness, tension

## Faster pickling, more accurate tolerances, provided by special G-E products for steel mills

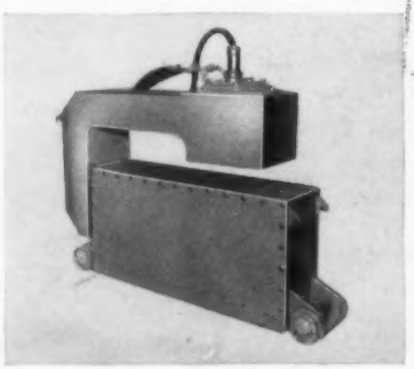
**Pickling lines run at higher speeds** when G-E Magnetic Loop Control keeps loop in proper position in the tank. Quick correction of deviations lets strip run at constant speed for more uniform pickling. Maintenance is cut by elimination of dancer rolls.

**Hot or cold mill operators get strip on gage faster,** roll to closer tolerances, with a G-E X-Ray Thickness Gage. Noncontacting, it gives accurate, continuous indication at high strip speeds.

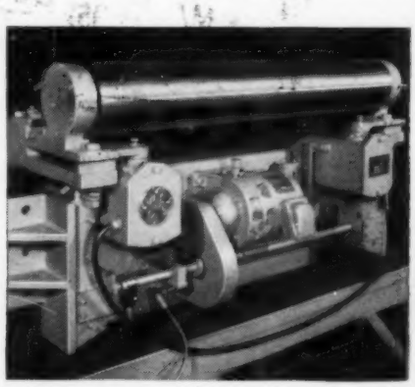
**Less strip breakage, fewer cobbles** result from accurate tension indication provided by G-E Tensiometer. Quick response enables use on tandem mills delivering strip at speeds up to 7000 fpm.

For more data on any of these products, see your G-E steel-mill representative or write for bulletins listed below to: General Electric, Sect., 687-85, Schenectady 5, N. Y.

**G-E MAGNETIC LOOP CONTROL** uses acid-proof pickup unit (l.), amplistat control unit (r.), and amplidyne to regulate speed of pinch rolls, maintain correct position of loop in tank. See Bulletin GEA-5618.



**G-E X-Ray Thickness Gage** measures thickness of fast-moving steel strip without contact. Top arm of 50-kv gage, shown above, contains detector; bottom tank contains x-ray tube. See Bulletin GEA-5622.



**G-E Tensiometer,** built from standard parts to fit special mill requirements, can be connected to tension-regulating circuits to regulate tension between stands automatically. See Bulletin GEA-5512.

GENERAL ELECTRIC

687-85